

SELECTED

WATER

RESOURCES

ABSTRACTS

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JUNE 1, 1979

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# SELECTED WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Research and Technology, U.S. Department of the Interior



VOLUME 12, NUMBER 11  
JUNE 1, 1979

W79-05001-W79-05500

The Secretary of the U.S. Department of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

ment. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

**A**s the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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**Selected** the sciences, engineering of the WRSIC (WRSIC) Interior and Science community by research, coordinating technical information and investment. To provide active work "centers

## FOREWORD

**Selected Water Resources Abstracts**, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus**. Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

**Selected Water Resources Abstracts** is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstract-

ing, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency. A directory of the Centers appears on the inside back cover.

Supplementary documentation is being secured from established discipline-oriented abstracting and indexing services. Currently an arrangement is in effect whereby the Bio-Science Information Service of Biological Abstracts supplies WRSIC with relevant references from the several subject areas of interest to our users. In addition to Biological Abstracts, references are acquired from Bioresearch Index which are without abstracts and therefore also appear abstractless in SWRA. Similar arrangements with other producers of abstracts are contemplated as planned augmentation of the information base.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center  
Office of Water Research and Technology  
U.S. Department of the Interior  
Washington, DC 20240

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- 03 WATER SUPPLY AUGMENTATION AND CONSERVATION**  
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- 06 WATER RESOURCES PLANNING**  
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## ABSTRACT SOURCES

## 1. NAT

### 1A. Pro

**NUMERIC THERMAL**  
Geological sources Dr. M. L. Sore Available DC 20402 sional Paper ref.

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### 2. WA

#### 2A. Ge

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C. A. Fed Water Re 1097, Dec

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# SELECTED WATER RESOURCES ABSTRACTS

## 1. NATURE OF WATER

### 1A. Properties

#### NUMERICAL MODELING OF LIQUID GEOTHERMAL SYSTEMS

Geological Survey, Menlo Park, CA. Water Resources Div.  
M. L. Sorey.

Available Supt. of Documents, GPO Washington DC 20402 price \$1.50. Geological Survey Professional Paper 1044-D, 1978. 25 p, 23 fig, 5 tab, 23 ref.

Descriptors: \*Geothermal studies, \*Mathematical models, \*Numerical analysis, \*Hot springs, \*Convection, Thermal water, Heat transfer, Mass transfer, Equations, Evaluation, \*Hydrothermal systems.

A mathematical model describing the physical behavior of hot-water geothermal systems is presented. The model consists of a set of coupled partial differential equations for heat and mass transfer in porous media and an equation of state relating fluid density to temperature and pressure. The equations are solved numerically using an integrated finite difference method which can treat arbitrary nodal configurations in one, two, or three dimensions. (Woodard-USGS).

W79-05173

## 2. WATER CYCLE

### 2A. General

#### SIMULATED STREAMFLOW RESPONSE TO POSSIBLE DIFFERENCES IN TRANSPIRATION AMONG SPECIES OF HARDWOOD TREES

Northeastern Forest Experiment Station, Durham, NH.

C. A. Federer, and D. Lash.  
Water Resources Research, Vol. 14, No. 6, p 1089-1097, December 1978. 8 fig, 4 tab, 17 ref.

Descriptors: \*Streamflow, \*Forest watersheds, \*Model studies, Transpiration, Trees, Water vapor, Hardwood, Simulation analysis, Speciation, Forests, Streams, \*Simulated streamflow, Leaf development, Annual streamflow.

Possible differences in transpiration among species of hardwood trees were simulated in a hydrologic model, called Brook, to estimate the effects of these differences on monthly and annual streamflow. Brook is a deterministic, lumped-parameter model that simulates streamflow from small, forested watersheds in the eastern United States. The model uses only daily mean temperature and daily precipitation as input. A 4-week difference in timing of leaf development in spring or color change in autumn caused differences of 10-60 mm in simulated annual streamflow. When daily transpiration varied by 20%, differences in simulated streamflow ranged from 15 to 120 mm annually. Differences in root distribution with depth can affect the availability of soil water; varying this availability causes differences in simulated streamflow of 15-60 mm. In all cases, the smaller differences occur when the soil is dry at the times of differing transpiration. On a deep residual soil, the differences in streamflow are spread throughout the year, but on a shallow till soil, the differences are restricted to the months in which there are changes in transpiration. Differences in response among 15 deg north-facing and 15 deg south-facing slopes and a horizontal surface were minor. (Roberts-ISWS)

W79-05018

#### ESTIMATING DESIGN FLOWS FOR URBAN DRAINAGE

British Columbia, Vancouver. Dept. of Civil Engineering.

For primary bibliographic entry see Field 2E.

W79-05024

#### THE DEVELOPMENT OF OVERLAND FLOW IN A TROPICAL RAINFOREST CATCHMENT

James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Geology.  
M. Bonell, and D. A. Gilmour.

Journal of Hydrology, Vol. 39, No. 3/4, p 365-382, December 1978. 4 fig, 4 tab, 29 ref.

Descriptors: \*Overland flow, \*Forests, \*Tropical regions, \*Australia, On-site investigations, On-site data collections, Rainfall, Precipitation(Atmospheric), Runoff, Subsurface flow, Rainfall intensity, Precipitation excess, Hydrographs, Hydraulic conductivity, Water table, Soil water, Watersheds(Basins), Hydrology, Analytical techniques.

A preliminary assessment was made of the factors contributing to the rapid response of the discharge hydrograph in a tropical rainforest catchment. Overland and subsurface flows were measured by means of a trough system constructed at the lower end of three sites. Water was led from each trough into a tipping-bucket device with which the number of tips was recorded mechanically using a hay-bale counter and electronically by a digital event recorder. Substantial overland flow occurred at all sites despite the exceedingly high average saturated hydraulic conductivity,  $k_{sub}$  values in the top 20 cm of the soil profile. The highest ratio of overland flow to subsurface flow was associated with a plot having an upslope position. Subsurface flow volumes, however, were higher at the two remaining plots of lower-slope position. This was attributed to the presence of residual rocks in the deeply weathered clays. The occurrence of widespread overland flow was explained by the occurrence of high-intensity rainfalls (particularly during the summer months). Such rainfalls frequently exceed the average  $k_{sub}$  values below 20 cm depth and, therefore, generate a widespread perched water table within the top 20 cm. This causes subsurface flow (particularly on steep slopes) through the highly permeable surface horizon. Additional rain causes the perched water table to emerge at the soil surface and, hence, widespread saturation overland flow results for the remainder of the storm. This overland flow is tapped by a temporary dense drainage network, thus accounting for the rapid quickflow response. Spearman's rank correlation coefficient analysis emphasized the significance of rainfall intensity despite some detailed differences between 'summer' and 'winter' rainfall events. It was concluded that in this particular environment, the variable source area concept of storm flow generation, associated with humid temperate areas, is not applicable mainly due to the characteristics of rainfall intensity. (Sims-ISWS)

W79-05030

#### MODELING NITROGEN MOVEMENT IN AGRICULTURAL WATERSHEDS

Florida Univ., Gainesville. Dept. of Agricultural Engineering.

For primary bibliographic entry see Field 2G.  
W79-05069

#### A MULTIVARIATE MODEL OF STORM-PERIOD SOLUTE BEHAVIOUR

Exeter Univ. (England). Dept. of Geography.

For primary bibliographic entry see Field 5B.

W79-05144

#### TRENDS IN STREAMFLOW DUE TO UPTREND LAND-USE CHANGES

University of the Witwatersrand, Johannesburg (South Africa). Hydrological Research Unit.

For primary bibliographic entry see Field 2E.  
W79-05147

#### DIGITAL SIMULATION AND EVALUATION OF STORM DRAINAGE SYSTEMS: ST. LOUIS HEIGHTS WATERSHED MODEL

Hawaii Univ., Honolulu. Water Resources Re-

search Center.

E. Yu-Si Fok, T. Murabayashi, and Sangan Phamwon.

Technical Report No. 114, November 1977. 138 p, 17 fig, 3 tab, 12 ref, 4 append.

Descriptors: Hydrology, Rainfall, Storms, Urban planning, computer, Computer models, Flood control, Hawaii, Infiltration, Runoff, Watershed.

The adequate design of a storm drainage system depends upon the proper estimation of various peak discharges (produced from a given storm) along the drainage network. The objective of this study is the development of a digital computer model utilizing available hydrologic data obtained during 1972 to 1975 to simulate runoff from given rainfall patterns in Hawaiian urban watersheds, and the development of procedures for channel flow routing through gutters and storm drains and runoff routing from previous and impervious areas. The computer model is the result of using the kinematic wave equation, which is most suitable to steep topographic terrain such as that of the study area, to modify the overland, gutter, and sewer flow routing procedures of the Illinois Urban Drainage Area Simulator (ILLUDAS) model. Available infiltration data were used to modify the infiltration process. Examples of the system capacity design and evaluation, and computer programs for the application of this simulation model are presented for user's adaptation.

W79-05225

#### OBTAINING VARIATIONS OF FIELD INFILTRATION CAPACITY FROM SIMULATED RAINSTORM EXPERIMENTS (DETERMINATION DES VARIATIONS DE LA CAPACITE D'ABSORPTION D'UN SOL EN PLACE SOUS AVERSES SIMULEES)

Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France). Hydrology Section.

For primary bibliographic entry see Field 2G.  
W79-05257

#### DEVELOPMENT OF A HYDROLOGIC MODEL FOR A CANADIAN WATERSHED

Department of the Environment, Ottawa (Ontario). Water Resources Branch.

G. W. Kite.

Canadian Journal of Civil Engineering, Vol. 5, No. 1, p 126-134, March 1978. 4 fig, 2 tab, 15 ref.

Descriptors: \*Canada, \*Watersheds(Basins), \*Parametric hydrology, \*Computer models, \*Simulation analysis, Optimization, Hydrographs, Snowmelt, Performance, Systems analysis, Magpie River(Ontario).

Three large well-known hydrologic models, the Streamflow Synthesis and Reservoir Regulation, the National Weather Service River Forecast System, and the Saskatchewan River Model No. 6, were calibrated and verified on a 2000 km<sup>2</sup> watershed in northern Ontario over two Spring snowmelt periods. Although results were adequate, it was thought that a smaller simpler model could be designed that would give results at least as good with much less expenditure of time, money, and effort. Details of the relative performances of the three existing and one new model are given, and comparative hydrographs are shown. The main interest in developing the simple parametric model was for flood forecasting. Although use of the models on only one basin cannot provide conclusive evidence of the models' relative goodness, the results obtained do show significant differences between the models as well as certain advantages for the new model. (Bell-Graff-Cornell)

W79-05280

#### URBAN RAINFALL-RUNOFF-QUALITY DATA BASE

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.

W. C. Huber, and J. P. Heaney.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-270 065. Price codes: A09 in paper copy, A01 in microfiche.

## Field 2—WATER CYCLE

### Group 2A—General

EPA-600/8-77-009. Prepared for: Municipal Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, OH. July 1977. 166 p, 45 fig, 68 tab, 181 ref. 68-03-0496.

Descriptors: \*Rainfall, \*Runoff, \*Water quality, \*Data collections, \*Storm sewers, Hydrology, Precipitation, Water pollution, Surveys, Documentation, Data storage and retrieval, Combined sewers, Mathematical models, Surface water runoff, Storms, Urban runoff.

Urban rainfall-runoff-quality data gathered by others have been assembled on a storm event basis for one or more catchments in the following eight cities: San Francisco (Cal.); Broward County (Fla.); Lincoln (Neb.); Durham (N.C.); Windsor (Ont.); Lancaster (Pa.); Seattle (Wash.); and Racine (Wis.). Rainfall-runoff data have been assembled for one or more catchments in an additional 13 cities: Baltimore (Md.); Chicago (Ill.); Champaign-Urbana (Ill.); Bucyrus (Ohio); Fall Church (Va.); Winston-Salem (N.C.); Jackson (Miss.); Wichita (Kan.); Westbury (N.Y.); Philadelphia (Pa.); Los Angeles (Cal.); Portland (Ore.); and Houston (Tex.). The 21 cities contain data for a total of 41 catchments. Descriptions of the catchments, parameters and sampling procedures are provided herein. Actual data have been placed on a magnetic tape and will be placed on the EPA STORET data retrieval system in the future. Additional data for the above cities and data for other cities will be included in the form of addenda to this report. Although none are presently included, data collected as part of current EPA Section 208 Area-wide Waste Management studies are expected to augment the data base in the future. (Bell-Graf-Cornell)

W79-05282

### 2B. Precipitation

RECORD WINTER STORMS IN ILLINOIS, 1977-1978, Illinois State Water Survey, Urbana. S. A. Changnon, Jr., and D. Changnon. Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 181. Price codes: A03 in paper copy, A01 in microfiche. Report of Investigation 88, 1978. 26 p, 12 fig, 6 tab, 6 ref.

Descriptors: \*Storms, \*Winter, \*Snow, \*Illinois, \*Central US, Snowfall, Snow cover, Ice, Blizzards, Winds, Damages, Hazards, Distribution patterns, Precipitation (Atmospheric), Effects, Highways, Temperature, Air temperature, Climatology, Meteorology, \*Winter storms, Severe winter storms, Snowstorms, Ice storms, Freezing rain.

The Midwest, including Illinois, experienced in 1977-1978 its most severe winter since weather records began in the early 19th century. The major impact in Illinois came from a record-breaking number of 18 severe winter storms. In a normal year, only 4 storms occur. The record winter began with three snowstorms in late November and ended with an extremely damaging ice storm in late March. Unusual snow patterns occurred with several storms, and they lasted in Illinois much longer than usual. Weather conditions (low pressure centers) producing many of the storms were more often of Canadian origin than usual, and these lows had lower pressure and moved slower than normal, resulting in higher surface winds and longer lasting and hence more severe storms. Cold temperatures coupled with the frequent snowstorms resulted in record long-lasting snow cover with up to 120 days with 1 inch or more cover in northern Illinois and 90 days in southern Illinois. The storms led to deaths of 62 persons and injuries to more than 2,000. Utilities and communication systems suffered great losses due to damage to lines, poles, and towers. Transportation losses included damaged vehicles, delayed shipments, and great delays in bus and airline service; however, railroads benefited with increased usage, and helicopters and snowmobiles proved valuable in rescue service. The local, state, and federal institu-

tions were beset with enormous and costly problems, including care of roads and lost taxable income due to absenteeism. (Sims-ISWS)

W79-05013

THE DEVELOPMENT OF OVERLAND FLOW IN A TROPICAL RAINFOREST CATCHMENT, James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Geology.

For primary bibliographic entry see Field 2A. W79-05030

### SOME ASPECTS OF FLORIDA CONVECTIVE RAINFALL

Virginia Univ., Charlottesville. Dept. of Environmental Sciences. S. L. Ulaniski, and M. Garstang. Water Resources Research, Vol. 14, No. 6, p 1133-1139, December 1978. 12 fig, 2 tab, 12 ref. NOAA 03-3-022-98, 03-5-022-37, NSF ATM76-14918.

Descriptors: \*Rainfall, \*Convection, \*Florida, Clouds, Fronts (Atmospheric), Networks, Precipitation (Atmospheric), Network design, Thunderstorms, \*Convective rainfall, \*Dense network, Intensity, Multishower days, Showers, Air-mass showers, Convective clouds.

A dense network of rain gages in an area of 660 sq km in south Florida was operated for the summers of 1971 and 1973. More than 3 times as much rain fell in this network in the summer of 1973 as in 1971. The two periods were examined in order to understand the controls in convective rainfall which produced such contrasting amounts. It was found that the total duration and intensity of rain was about the same in both years. Well-organized thunderstorms of large extent accounted for the bulk of the rainfall. These large storms occurred with a greater frequency in 1973 than in 1971. Days with single showers produced more rain than multishower days. The critical variable in determining convective rainfall amount is the size of the individual storm. These large storms appear to eliminate competition for the available moisture supply and are more efficient in converting that moisture to rainfall. (Roberts-ISWS)

W79-05139

### CALCITE AS A SOURCE OF EXCESS CALCIUM IN RAINWATER

Tokyo Inst. of Tech. (Japan). Dept. of Environmental Chemistry. For primary bibliographic entry see Field 2K. W79-05262

### 2C. Snow, Ice, and Frost

RADAR ANISOTROPY OF SEA ICE DUE TO PREFERRED AZIMUTHAL ORIENTATION OF THE HORIZONTAL C AXES OF ICE CRYSTALS, Army Terrestrial Sciences Center, Hanover, NH. Earth Sciences Branch.

A. Kovacs, and R. M. Morey. Journal of Geophysical Research, Vol. 83, No. C12, p 6037-6046, December 20, 1978. 6 fig, 2 tab, 36 ref. ONR NR 307-393, NOAA 01-5-022-1651.

Descriptors: \*Sea ice, \*Radar, \*Crystals, Anisotropy, Heterogeneity, Ice, Electrical properties, Currents (Water), Oceans, Cold regions, Arctic, Remote sensing, On-site investigations, Ice c axis.

Results of impulse radar, ice crystal c axis, and subice current measurements on the fast ice near Narwhal Island, Alaska, were presented. The crystal structure of the ice was found to have a horizontal crystal c axis with a preferred azimuthal orientation. This orientation was found to align with the direction of the current at the ice-water interface. Impulse radar reflection measurements revealed that the preferred orientation of the sea ice crystal structure behaved as a microwave polarizer. It was observed that when the antenna E field was oriented parallel with the c axis of the crystal platelets, a strong reflection of the radar

signal from the bottom of the ice was obtained. However, when the antenna E field was oriented perpendicular to the c axis, no bottom reflection was detected. The results of this study fully support earlier reports of sea ice inhomogeneity and anisotropy in reference to both structure and electromagnetic energy transmission. (Sims-ISWS)

W79-05138

### SNOW-COVERED AREA UTILIZATION IN RUNOFF FORECASTS

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center. A. Rango, J. F. Hannaford, R. L. Hall, M. Rosenzweig, and A. J. Brown. Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY1, Proceedings Paper 14326, p 53-66, January 1979. 5 fig, 3 tab, 4 ref. NASA NAS5-22957.

Descriptors: \*Aerial photography, \*Aircraft, \*California, Forecasting, Remote sensing, Runoff, Satellites (Artificial), Runoff forecasting, Snow, Snow cover, Water resources, \*Sierra Nevada Mountains, \*Kern River Watershed, \*Kings River Watershed, Long-term data, Satellite observations, Melt season.

Long-term data on snow-covered area from aircraft and satellite observations were investigated for application to water-supply forecasting in California's southern Sierra Nevada Mountains. These observations proved useful in reducing seasonal runoff forecast error on the Kern River watershed when incorporated into procedures to update water-supply forecasts as the melt season progressed. Similar use of snow-covered area on the Kings River watershed produced results that were about equivalent to methods based solely on conventional data. Snow-covered area was most effective in reducing forecast procedural error on an erratic precipitation or snowpack accumulation pattern, or both, not strongly related to elevation; and poor coverage by precipitation stations or snow courses restricted adequate indexing of water-supply conditions. When satellite data acquisition and delivery problems were resolved, the derived snow-cover information should provide a means for enhancing operational streamflow forecasts. (Roberts-ISWS)

W79-05140

### MELTING OF A PRAIRIE SNOWPACK

Saskatchewan Univ., Saskatoon. Div. of Hydrology. R. J. Granger, and D. H. Male. Journal of Applied Meteorology, Vol. 17, No. 12, p 1833-1842, December 1978. 13 fig, 2 tab, 22 ref.

Descriptors: \*Melting, \*Snowpacks, \*Snowmelt, \*Canada, Grasslands, Snow cover, Energy budget, Energy transfer, On-site investigation, Instrumentation, On-site data collections, Data processing, Mathematical models, Temperature, Thawing, Runoff, Melt water, Prairie snowpacks.

An energy budget approach was used to study the melt of a prairie snowpack. Air temperature, humidity, and wind speed were measured at 7 levels in the first 2 m above the snow surface. Evaporation and melt were measured directly with a weighing lysimeter which enables all the terms of the energy budget to be determined independently. On the basis of results from 3 spring melt periods, the net radiation flux is shown to be the major source of energy for the melt periods, the net radiation flux is shown to be the major source of energy for the melt of a continuous snowcover. In the absence of local advection, the sensible heat flux is shown to be a function of the energy content of the air mass and more closely related to the 850 mb temperature than to temperatures near the snow surface. The latent heat flux responds to the radiation flux with daytime evaporation and nighttime condensation; however, the net daily flux is usually evaporative. (Sims-ISWS)

W79-05252

THE APPLIED SCANNING PROBLEM, Guelph Univ. Science. J. B. Goit, J. P. Loch, Soil Science, No. 6, p 85-10 ref.

Descriptors: meters, \*M, \*ion, Moisture, Ice, Soil science, D

The attention provides a swelling plus. However, due to the same plane attention. The calculation lower than and some water content averaged of excess of during the form in the equation of beam in a technical was suggested equations W79-05266

A MODEL NAVIGATOR, Acres Int. J. E. Cowi, Canadian, 3, p 380-35

Descriptors: \*Ice cover, Lake Huron, Channels, Temperature

Ice conditions winter near Lake Huron winter regime and river. A h of the wa Soo Lock relieving ice behavior study. An ship passage was developed model test at the end five under 1975-1976 Graf-Cor W79-05277

COMPUTER DUCED EXPERIMENTAL RESULTS, Northwesterly chemical R. Keriba Canadian 3, p 362-

Descriptors: \*Heat tr, \*Melting, water, Equations



## Streamflow and Runoff—Group 2E

## THE APPLICABILITY OF DUAL GAMMA SCANNING TO FREEZING SOILS AND THE PROBLEM OF STRATIFICATION,

Guelph Univ. (Ontario). Dept. of Land Resource Science  
J. B. Goit, P. H. Groenevelt, B. D. Kay, and J. G. P. Loch.

Soil Science Society of American Journal, Vol. 42, No. 6, p 858-863, November-December 1978. 6 fig, 10 ref.

Descriptors: \*Frozen soils, \*Nuclear moisture meters, \*Moisture content, Freezing, Instrumentation, Moisture meters, Soils, Density, Stratification, Ice, Soil water, Gamma rays, Nuclear meters, Soil science, Dual gamma scanning.

The attenuation of a dual energy gamma beam provides a powerful technique for studying the swelling phenomenon associated with soil freezing. However, the development of a stratified system due to the formation of a discrete ice lens in the same plane as the gamma beam requires special attention. Erroneous results are obtained when attenuation equations which are developed for homogeneous mixtures are applied to stratified media. The calculated dry bulk densities are then always lower than the averaged actual dry bulk densities and sometimes even negative. The calculated water contents are then always higher than the averaged actual water contents and sometimes in excess of 1 g/cu cm. Stratification also may occur during the shrinking of unfrozen soil when cracks form in the same plane as the gamma beam. The equation describing the attenuation of a gamma beam in a stratified medium was formulated. A technical modification in the scanning procedure was suggested in order to solve the appropriate equations and to locate the interface. (Sims-ISWS) W79-05260

## A MODEL STUDY OF ST. MARYS RIVER ICE NAVIGATION,

Acres International Ltd., Niagara Falls (Ontario).  
J. E. Cowley, J. W. Hayden, and W. W. Willis.  
Canadian Journal of Civil Engineering, Vol. 4, No. 3, p 380-391, September 1977. 10 fig.

Descriptors: \*Hydraulic models, \*Model studies, \*Ice cover, \*Navigation, Winter, Lake Superior, Lake Huron, Canada, Great Lakes, United States, Channels, Harbors, Ships, Simulation analysis, Temperature, Effects, Systems analysis.

Ice conditions on the St. Marys River hamper winter navigation between Lake Superior and Lake Huron. Vessel movements in the river during winter months lead to changes in the river ice regime and affect local ferry service across the river. A hydraulic scale model of a 7300-m length of the waterway extending downstream from the Soo Locks was used to compare alternatives for relieving these effects. Methods for representing ice behavior were a key element in the model study. An arrangement of ice booms with an open ship passage which does not impede navigation was developed and recommended on the basis of model tests. That boom arrangement was installed at the end of 1975 and proved to be highly effective under the ice conditions experienced in the 1975-1976 and 1976-1977 winter seasons. (Bell-Graf-Cornell) W79-05278

## COMPUTER SIMULATION OF BUBBLER-INDUCED MELTING OF ICE COVERS USING EXPERIMENTAL HEAT TRANSFER RESULTS,

Northwestern Univ., Evanston, IL. Dept. of Mechanical Engineering.

R. Keribar, R. S. Tankin, and G. D. Tan.  
Canadian Journal of Civil Engineering, Vol. 5, No. 3, p 362-366, September 1978. 4 fig, 1 tab, 9 ref.

Descriptors: \*Simulation analysis, \*Ice cover, \*Heat transfer coefficients, \*Bubbler systems, \*Melting, Computers, Winter, Water bodies, Deep water, Behavior, Performance, Temperature, Equations, Thickness, Prediction, Finite difference

method, Weather data, Site characteristics, Systems analysis.

After a brief description of the physical phenomenon associated with artificial suppression of winter ice sheets over water bodies by 'Bubbler systems' or submerged air injectors, results of laboratory experiments conducted to determine bubbler-induced heat transfer coefficients are reported. Implications and validity of results are discussed. As a second step, a procedure for computer-simulating the behavior of an ice sheet whose thickness is controlled by a bubbler system operating intermittently over a long period of time is developed. The simulation uses experimentally determined bubbler heat transfer coefficients, weather data, site characteristics, and desired performance as input data, and a finite difference method to solve the equations governing the ice thickness and temperature profile. Through an example simulation, the usefulness of the procedure in predicting ice thickness and temperature profile histories and the effectiveness or suitability of a given bubbler system are demonstrated. (Bell-Graf-Cornell) W79-05279

## 2D. Evaporation and Transpiration

## SIMULATED STREAMFLOW RESPONSE TO POSSIBLE DIFFERENCES IN TRANSPIRATION AMONG SPECIES OF HARDWOOD TREES,

Northeastern Forest Experiment Station, Durham, NH.

For primary bibliographic entry see Field 2A.  
W79-05018

## RUNOFF CURVE NUMBERS WITH VARYING SITE MOISTURE,

Utah State Univ., Logan. Dept. of Forestry and Outdoor Recreation.  
R. H. Hawkins.

Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 104, No. 1R4, Proceedings Paper 14254, p 389-398, December 1978. 5 fig, 3 tab, 4 ref, 2 append.

Descriptors: \*Soil moisture, \*Runoff coefficient, \*Antecedent moisture content, \*Infiltration, Rainfall, Evapotranspiration, Drainage, Runoff, Equations, Mathematical studies, Storms, \*Runoff curve numbers, Soil conservation service.

Runoff curve numbers are used to estimate runoff from storm rainfall. These numbers are usually modified by handbook methods to account for the influence of watershed wetness. An alternate technique, based on the Soil Conservation Service (SCS) rainfall runoff formula and conservation of mass, was developed. The methodology requires inputs of the interim evapotranspiration and drainage, but it is not unreasonably sensitive to estimates. The relationships derived may be used, with judgment, as an alternate to handbook methods. (Singh-ISWS) W79-05023

## 2E. Streamflow and Runoff

## WEAR OF UNSOUND PEBBLES IN RIVER HEADWATERS,

Cornell Univ., Ithaca, NY. Dept. of Geological Sciences.

For primary bibliographic entry see Field 2J.  
W79-05016

## RELATIONSHIP BETWEEN ALLUVIAL SOILS AND FLOODING IN THE PIEDMONT LOWLAND OF SOUTHEASTERN PENNSYLVANIA,

Pennsylvania Univ., Philadelphia. Dept. of Landscape Architecture and Pennsylvania Univ., Philadelphia. Regional Planning Div.  
H. Price, and A. Johnson.  
Water Resources Research, Vol. 14, No. 6, p 1189-1194, December 1978. 7 fig, 17 ref.

Descriptors: \*Floods, \*Flood frequency, \*Soils, \*Alluvial channels, \*Pennsylvania, Alluvium, Soil types, Flood forecasting, Flood recurrence interval, Regression analysis, Flood plain zoning, Flood plains, Planning, Probability, Data processing, Analytical techniques, Flood plain soils.

Regressions of 50- and 100-year synthetic flood widths on widths of alluvial soils bordering the stream were computed with confidence intervals for data from streams in the Piedmont Lowland of southeastern Pennsylvania. These intervals were too wide to recommend use of alluvial soils in floodplain zoning in this gently rolling terrain. A rule of thumb of 2 1/2 times the alluvial soils width was suggested for safe location of land uses for which flooding would be intolerable. Data for one of the minor soils indicated that some soils may delineate flood hazard areas better than others, but too few data were available for complete analysis. (Sims-ISWS) W79-05017

## SIMULATED STREAMFLOW RESPONSE TO POSSIBLE DIFFERENCES IN TRANSPIRATION AMONG SPECIES OF HARDWOOD TREES,

Northeastern Forest Experiment Station, Durham, NH.

For primary bibliographic entry see Field 2A.  
W79-05018

## BEHAVIOUR OF A HYDRODYNAMIC FINITE ELEMENT MODEL,

Waterloo Univ. (Ontario). Dept. of Civil Engineering.

For primary bibliographic entry see Field 8B.  
W79-05020

## RUNOFF CURVE NUMBERS WITH VARYING SITE MOISTURE,

Utah State Univ., Logan. Dept. of Forestry and Outdoor Recreation.

For primary bibliographic entry see Field 2D.  
W79-05023

## ESTIMATING DESIGN FLOWS FOR URBAN DRAINAGE,

British Columbia, Vancouver. Dept. of Civil Engineering.

S. O. Russell, B. F. I. Kenning, and G. J. Sunnell.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY1, Proceedings Paper 14317, p 43-52, January 1979. 2 fig, 1 tab, 14 ref, 1 append.

Descriptors: \*Drainage, \*Model studies, \*Canada, Hydraulic models, Peak discharge, Flow, Storm runoff, Storm water, Estimating, Urbanization, Urban drainage, \*Peak runoff.

As an area urbanizes, peak runoff tends to increase. But the effects of urbanization on storm flows can be offset by a policy of requiring detention storage. A new method for computing design flows and storage volumes was developed to prepare a master drainage plan for a municipality in Western Canada. The method involves use of a hydrologic model to analyze all the significant storms of record over the range of parameter values likely to apply in the area, a frequency analysis of the compound peaks, storage of the results in a large matrix in a computer, and subsequent interpolation of the stored data. By inputting estimated values of the parameters for any particular basin, the user can obtain peak flows for any desired return period and also the amount of detention storage required. Parameters can be specified either with single values or by ranges, taking into account parameter uncertainty. (Lee-ISWS) W79-05024

## SIZING OF RESERVOIRS FOR PERIODIC-STOCHASTIC INPUT AND PERIODIC OUTPUT,

Engineering Consultants, Inc., Denver, CO.  
For primary bibliographic entry see Field 2H.

## Field 2—WATER CYCLE

### Group 2E—Streamflow and Runoff

W79-05029

**THE DEVELOPMENT OF OVERLAND FLOW IN A TROPICAL RAINFOREST CATCHMENT,** James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Geology. For primary bibliographic entry see Field 2A. W79-05030

**DIGITAL SIMULATION OF SNOWMELT RUNOFF,** Nevada Univ. System, Reno. Water Resources Center.

R. G. Merritt.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 252. Price codes: A06 in paper copy, A01 in microfiche. Publication No 41053, April 1978. 107 p, 20 fig, 2 tab, 20 ref. OWRP A-076-NEV(1). 14-34-0001-7060.

Descriptors: \*Snowmelt, Dewpoint temperature, Computer programs, Runoff, Simulation.

A computer program was developed for snowmelt runoff simulation. The program utilized the physical equations presented in SNOW HYDROLOGY (Corps of Engineers, U.S. Army, 1956) describing heat budget components involved in snowmelt. The model requires initial snow depth and water equivalent estimates, along with continuous air temperature, dewpoint temperature, wind speed and shortwave and longwave radiation readings as input. If radiation observations are unavailable, the model will estimate missing components. Results show that an improved meteorologic data base is required to gain acceptable snowmelt runoff simulation with the model. (Smith-Nevada) W79-05091

**CHARACTERISTICS OF THE OSWEGO RIVER PLUME AND ITS INFLUENCE ON THE NEARSHORE ENVIRONMENT,** National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab. G. L. Bell. NOAA Technical Memorandum ERL GLERL-22, October 1978. 85 p, 55 fig, 8 tab, 19 ref. Also as Great Lakes Environmental Research Laboratory Contribution No. 163.

Descriptors: \*Rivers, \*Lakes, \*Sediments, Water pollution, Streamflow, Suspended solids, Dredging, Water pollution sources, Lake Ontario, Near-shore environment.

Ion and suspended material concentrations were relatively high in the Oswego River as compared to Lake Ontario background levels and generally decreased rapidly through Oswego Harbor. There were indications of loading of nutrients, chloride, chemical oxygen demand, and volatiles other than from the river. However, oxygen depletion was not a problem in any area. Transmissometer profiles were used to supplement the chemical and temperature data. They conventionally detail the plume structure. Plume configurations varied in response to stream flow, prevailing longshore currents, and current variations related to changes in wind direction and velocity. Suspended materials varied with river flow. During low flow periods these materials are deposited in the harbor on either side of the channel and in the plume area adjacent to the harbor. Dredging operations resuspend some materials, which are then redistributed. Dredged spoil deposited offshore produces an additional impact on the deeper portion of the lake. The combined effects of longshore and wave generated currents tend to keep the materials moving. Movement of fine particulates over a thermocline surface provides a mechanism by which these materials are kept in suspension and widely distributed. (NOAA) W79-05118

**FLOW RESISTANCE OF LARGE-SCALE ROUGHNESS,**

Colorado State Univ., Fort Collins. Dept. of Civil Engineering. J. C. Bathurst.

Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 104, No. HY12, Proceedings Paper 14239, p 1587-1603, December 1978. 8 fig, 3 tab, 21 ref, 2 append.

Descriptors: \*Channels, \*Flow resistance, \*Roughness(Hydraulic), Hydraulics, Resistance, Sediments, Velocity, Rivers, Drag, Boulders, \*England, \*River Tees(England), Boundary shear, Velocity distribution.

A theory of the resistance to flow in rivers with large-scale roughness was developed, and a resistance equation was constructed using data from the upper River Tees, England. The theoretical analysis showed that, in channels with large values of relative roughness, resistance to flow depends mainly on the size, shape, spacing, and size distribution of the boundary roughness elements. Channel geometry is important only in its effect on the drag of the elements. This theory was illustrated using data from field sites at which roughness shape and size distribution were similar and roughness spacing could be directly related to relative roughness. In the resistance equation (which is specific to the field sites), the resistance coefficient varies with just relative roughness and a parameter of channel geometry. (Lee-ISWS) W79-05141

**EXPECTED ASYMPTOTIC MAXIMUM DEFICIT FOR PERIODIC-STOCHASTIC RESERVOIR INFLOWS IN CASE OF PARTIAL FLOW REGULATION,** Engineering Consultants, Inc., Denver, CO. For primary bibliographic entry see Field 2H. W79-05145

**TRENDS IN STREAMFLOW DUE TO UPSTREAM LAND-USE CHANGES,** University of the Witwatersrand, Johannesburg (South Africa). Hydrological Research Unit. W. V. Pitman. Journal of Hydrology, Vol. 39, No. 3/4, p. 227-237, December 1978. 10 fig, 4 ref.

Descriptors: \*Model studies, \*Streamflow, \*Land use, \*Rainfall-runoff relationships, Watersheds(Basins), Hydrology, Effects, Forests, Upstream, Analysis, Equations, Rainfall-runoff models, Non-stationary processes.

Most streamflow records are affected to some degree by changes in man's activities in the catchment. Records displaying trends must be rendered stationary before being subjected to further analysis. With the aid of rainfall-runoff models, not only can non-stationarity be detected, but the cause can be identified and quantified. Moreover, the effects on streamflow of further changes of the type identified can be predicted. The influence of upstream afforestation on streamflow was illustrated by worked examples. (Lee-ISWS) W79-05147

**EVALUATION AND DESIGN OF A STREAMFLOW-DATA NETWORK IN WASHINGTON,** Geological Survey, Reston, VA. Water Resources Div., and Geological Survey, Tacoma, WA. Water Resources Div. For primary bibliographic entry see Field 7A. W79-05159

**7-DAY LOW FLOWS AND FLOW DURATION OF ALABAMA STREAMS THROUGH 1973,** Geological Survey, Jacksonville, FL. Water Resources Div. E. C. Hayes. Alabama Geological Survey Division of Water Resources Bulletin 113, 1978. 163 p, 1 fig, 2 plates, 5 tab, 9 ref.

Descriptors: \*Low flow, \*Data collections, \*Alabama, \*Streams, \*Average flow, Flow duration,

Gaging stations, Natural flow, Regulated flow, Maps, Flow measurement, Sites.

Estimates for one or both low-flow parameters (annual 7-day low flows with 2-year and 10-year recurrence intervals) are tabulated for 527 locations on 341 different streams in Alabama. Drainage area for these sites range from 1.3 square miles to 43,000 square miles. The average discharge and flow-duration tables were computed for selected period of record at 223 stream-gaging stations on 141 different streams. (Woodard-USGS) W79-05166

**INTERACTING EFFECTS OF MINIMUM FLOW AND FLUCTUATING SHORELINES ON BENTHIC STREAM INSECTS,** Idaho Univ., Moscow. Dept. of Entomology. M. A. Brusven, and E. F. Trihey. Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 358. Price codes: A05 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, University of Idaho, Research Technical Completion Report, August 1978. 78 p, 26 fig, 10 tab, 26 ref. OWRP A-052-IDA(1), 14-34-0001-8014.

Descriptors: \*Minimum flows, \*Benthic habitat, \*Aquatic insects, Low flow, Dworshak Dam, Water releases, Clearwater River, Hydroelectric powerplants, Fluctuating flows.

A 50 mile (80 km) reach of the Clearwater River, Idaho was studied from its confluence with the Snake River upstream to Orofino, Idaho. The study examined two important changes in the River: (1) effects of hydropower releases from Dworshak Dam on the aquatic insect community in the free flowing reach of the Clearwater River, and (2) backwater effects of Lower Granite Dam on benthos in the lower five mile (8 km) of the Clearwater River. While small to moderate shifts in seasonal densities of principal species have occurred between intensive study sites above and below the influence of Dworshak Dam, evidence does not indicate these shifts are attributable to hydropower releases. Approximately one month was required for sterile rocks to support a standing crop similar to that of continually watered rocks. Although hydropower releases cause frequent and marked fluctuations in discharge, there is a stable post project low flow. Higher late summer flow guarantees the submergence of additional substrate, thereby increasing macrobenthic habitat. Drift rates and standing crop relationships above and below the influence of Dworshak Dam suggest insects drifted more in response to daily fluctuations than to the factor of bottom density. Formation of Lower Granite reservoir has resulted in insect community shifts from a riverine to a lentic community. W79-05233

**MIXING OF POWER-PLANT HEATED EFFLUENTS WITH THE MISSOURI RIVER,** Iowa Univ. Iowa City. Inst. of Hydraulic Research. For primary bibliographic entry see Field 5B. W79-05245

**FLOOD HAZARD ANALYSES: LITTLE CATOCTIN CREEK AND TRIBUTARIES, FREDERICK COUNTY, MARYLAND,** Soil Conservation Service, College Park, MD. January 1978. 19 p, 5 fig, 3 tab, 10 ref, 8 append.

Descriptors: \*Flood plain zoning, \*Flood frequency, \*Flood profiles, \*Land use, \*Maryland, Topography, Soil types, Snowmelt, Hydrology, Tributaries, Streams, \*Little Catoctin Creek (MD), \*Flood hazard maps, \*Frederick County (MD), Flood plain management.

This report contained flood hazard information for the Little Catoctin Creek, a southwestern stream which empties directly into the Potomac River. The watershed lies within the Blue Ridge physiographic province. The soils have moderate infiltration rates and runoff potentials during a flood

event. Past shed, and a mile reach record combined with recurrence hazard are year flood, 50-, and cross section information management. W79-05246

**EFFECTIVE BED UNDER INDIAN ENGINEERING** For primary W79-05254

**A SIMPLIFIED METHOD FOR MOSUL G. AI-MARJUDA.** Hydrology 373-380, S

Descriptor: cal meth models, Discharge Hydrology \*Gumbel's

Gumbel's that one period flow and work variation of the simpl obtained and those method. W79-05259

**INFLUENCE OF SORGHUM AND ERGOT ON SCIENCE AT TX. GRA** For primary W79-05259

**2F. Gr**

**THE SET QUALITY AND KN** Texas De Report 22 ref, 1 app

Descriptor: \*Data Groundwater capacity, Groundwater Nitrates, Hardness wells, W Haskell mour aqu

This two water res and Kno quality, included. tion was of: (1) the past, to the ac and, (3) from the related il



## Groundwater—Group 2F

algorithm was applied to the calibration of an aquifer model for the Tehran region of Iran. The results showed that the mean error was reduced by a factor of 3 with respect to the initial parameter estimates. (Sims-ISWS)  
W79-05026

**RADIAL DISPERSION TO AN ABSTRACTION WELL,**  
Birmingham Univ. (England). Dept. of Civil Engineering.  
A. N. S. Al-Niami, and K. R. Rushton.  
Journal of Hydrology, Vol. 39, No. 3/4, p 287-300, December 1978. 7 fig, 4 tab, 7 ref, 1 append.

Descriptors: \*Dispersion, \*Groundwater, \*Pollutants, \*Water wells, \*Model studies, Mathematical models, Equations, Numerical analysis, Groundwater movement, Flow, Aquifers, Wells, Water pollution, Hydrology.

Analytical expressions were derived for the radial dispersion through an aquifer towards an abstraction well. Since the problem was a finite system involving two boundary conditions, analytical expressions could be obtained only for certain specific non-dimensional discharge rates. These expressions were evaluated numerically for a wide range of parameter values, and the results were presented as families of curves. A particular example showed that if the distance between the abstraction well and the source of contamination exceeds a critical distance, then contamination of the well is unlikely to occur. (Sims-ISWS)  
W79-05027

**FINITE-DIFFERENCE SOLUTIONS FOR ONE-DIMENSIONAL DISPERSION USING AN IMPROVED MESH DESIGN,**  
Birmingham Uni. (England). Dept. of Civil Engineering.  
A. N. S. Al-Niami, and K. R. Rushton.  
Journal of Hydrology, Vol. 39, No. 3/4, p 301-310, December 1978. 6 fig, 2 tab, 11 ref.

Descriptors: \*Dispersion, \*Groundwater, \*Porous media, \*Model studies, Mathematical models, Equations, Numerical analysis, Analytical techniques, Groundwater movement, Aquifers, Pollutants, Water pollution, Hydrology.

Two new finite-difference methods were proposed for analyzing one-dimensional dispersion problems in porous media. The essential feature of these methods is that the grid points are positioned in the regions of rapid change in concentration. Problems were analyzed with both constant and variable velocity and dispersion coefficients. (Sims-ISWS)  
W79-05028

**HYDROGEOLOGY OF BERMUDA—SIGNIFICANCE OF AN ACROSS-THE-ISLAND VARIATION IN PERMEABILITY,**  
Washington State Univ., Pullman. Dept. of Geology.  
For primary bibliographic entry see Field 2L.  
W79-05031

**GROUND-WATER POLLUTION—A LIMITED PROBLEM,**  
Dunn Geoscience Corp., Latham, NY.  
For primary bibliographic entry see Field 5B.  
W79-05122

**GROUND-WATER QUALITY STANDARDS—A NEUTRAL VIEW,**  
Michigan Dept. of Public Health, Lansing.  
For primary bibliographic entry see Field 5B.  
W79-05123

**GROUND-WATER QUALITY STANDARDS—RELEVANT,**  
Environmental Protection Agency, Washington, DC. Office of Drinking Water.  
For primary bibliographic entry see Field 5B.  
W79-05124

event. Pasture and crops cover 83% of the watershed, and about 17% is under forest cover. An 18.3 mile reach of the creek was studied. The flood of record occurred in 1936 due to frontal rains combined with spring snow melt. This flood had a recurrence interval of about 100 years. Flood hazard area maps showing the 500-year and 100-year flood limits and flood profiles of the 500-, 100-, 50-, and 10-year water surfaces along with typical cross sections were included in the report. The information presented will be useful for flood plain management in the watershed. (Singh-ISWS)  
W79-05246

**EFFECTIVE DEPTH IN CHANNELS HAVING BED UNDULATIONS,**  
Indian Inst. of Tech., Kharagpur. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 2J.  
W79-05254

**A SIMPLE VERSION OF GUMBEL'S METHOD FOR FLOOD ESTIMATION,**  
Mosul Univ. (Iraq). Dept. of Civil Engineering.  
G. Al-Mashidani, B. B. L. Pande, and M. F. Mujda.  
Hydrological Sciences Bulletin, Vol. 23, No. 3, p 373-380, September 1978. 2 fig, 4 tab, 7 ref.

Descriptors: \*Floods, \*Flood forecasting, \*Statistical methods, Statistical models, Mathematical models, Rivers, Streamflow, Flood frequency, Discharge(Water), Runoff, Analytical techniques, Hydrology, Foreign countries, Foreign research, \*Gumbel's method, \*Iraq.

Gumbel's method was simplified in such a manner that one can obtain the magnitude of a given return period flood without recourse to looking at a table and working out the value of the coefficient of variation of the given data. The results obtained by the simplified version were compared with those obtained from using both the original approach and those from Powell's modification of Gumbel's method. (Sims-ISWS)  
W79-05256

**INFLUENCE OF ROW SPACING OF GRAIN SORGHUM ON GROUND COVER, RUNOFF, AND EROSION,**  
Science and Education Administration, Temple, TX. Grassland, Soil and Water Research Lab.  
For primary bibliographic entry see Field 3F.  
W79-05258

## 2F. Groundwater

**THE SEYMOUR AQUIFER GROUND-WATER QUALITY AND AVAILABILITY IN HASKELL AND KNOX COUNTIES, TEXAS, VOLUME I.**  
Texas Dept. of Water Resources, Austin.  
Report 226, December 1978. 73 p, 56 fig, 10 tab, 80 ref, 1 append.

Descriptors: \*Aquifers, \*Groundwater resources, \*Data collections, \*Texas, \*Water quality, Groundwater availability, Pumping, Specific capacity, Transmissivity, Zone of saturation, Groundwater movement, Water level fluctuations, Nitrates, Dissolved solids, Sulfates, Chlorides, Hardness(Water), Water pollution sources, Oil wells, Water wells, Oil wastes, Hydrogeology, \*Haskell County(TX), \*Knox County(TX), \*Seymour aquifer, Saturated thickness.

This two volume report described the groundwater resources of the Seymour aquifer in Haskell and Knox Counties, Texas. Emphasis was on water quality, but important availability information was included. The primary objective of the investigation was to gain a comprehensive understanding of: (1) the water quality in the Seymour aquifer; (2) the past, present, and potential sources of pollution to the aquifer due primarily to mineralized water; and, (3) the future quality and availability of water from the aquifer. Volume I contained text and related illustrations and tables describing the qual-

ity and quantity of the groundwater resources of the Seymour aquifer. It included an explanation of the geology as related to the occurrence of groundwater, the groundwater conditions in the Seymour, groundwater in other formations, and pollution in the Seymour. Provided was information intended to aid in obtaining maximum benefits from the Seymour aquifer and to assist regulatory agencies in protecting the aquifer from pollution. Volume II contained supporting basic data consisting of maps and tables. The Seymour aquifer is the only source of moderate-to-large supplies of fresh groundwater within the area. No alternative fresh supplies exist from deeper formations. The aquifer underlies 274,500 acres and furnishes water to over 2,000 irrigation wells. Municipal, domestic, and stock supplies are also dependent on the Seymour. (See also W79-05015) (Humphreys-ISWS)  
W79-05014

**THE SEYMOUR AQUIFER GROUND-WATER QUALITY AND AVAILABILITY IN HASKELL AND KNOX COUNTIES, TEXAS, VOLUME II.**  
Texas Dept. of Water Resources, Austin.  
For primary bibliographic entry see Field 7C.  
W79-05015

**DISTRIBUTED SOURCES FOR UNCONFINED GROUNDWATER FLOW IN A HALF-SPACE,**  
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.  
O. D. L. Strack.  
Journal of Hydrology, Vol. 39, No. 3/4, p 239-253, December 1978. 7 fig, 10 ref, 1 append.

Descriptors: \*Aquifers, \*Groundwater movement, \*Mathematical models, \*Equations, Water table aquifers, Drains, Homogeneity, Theoretical analysis, Water table, Saturated flow, Model studies, Conformal mapping, Boundary integrals.

The exact solution to a problem of unconfined saturated flow of groundwater in a semi-infinite homogeneous and isotropic permeable medium was presented. The inflow and outflow occur along an arbitrary number of segments of the phreatic surface. The inflow and outflow rates are constant along each segment, but the rates may vary from segment to segment. The solution was determined by conformal mapping techniques applying boundary integrals. (Visocky-ISWS)  
W79-05025

**A NON-LINEAR OPTIMIZATION METHOD FOR THE ESTIMATION OF AQUIFER PARAMETERS,**  
Institute of Hydrology, Wallingford (England).  
P. J. Smith, and B. S. Piper.  
Journal of Hydrology, Vol. 39, No. 3/4, p 255-272, December 1978. 5 fig, 3 tab, 17 ref.

Descriptors: \*Aquifers, \*Transmissivity, \*Storage coefficient, \*Model studies, Mathematical models, Algorithms, Equations, Recharge, Natural recharge, Groundwater, Groundwater movement, Storage, Water levels, Hydrology, \*Iran, \*Tehran(Iran).

An algorithm for the estimation of the aquifer parameters of transmissivity and storage coefficient from historic water level and recharge data was presented. The estimated parameters can be used to develop a transient groundwater model. The estimation of these parameters is in two parts. The transmissivities are estimated initially for periods of balanced recharge using the steady-flow equations. Using these transmissivities, the storage coefficients are estimated from the transient-flow equations. No additional simplifications (such as polynomial surface representation of transmissivity) are required, thereby aiding the hydrogeological interpretation of the results. The finite-difference method of successive over-relaxation was used for the numerical solution of the steady- and transient-flow equations. For the estimation of both transmissivity and storage coefficient, a hybrid non-linear optimization method was used to minimize the difference between the observed water levels and those predicted from the flow equations. The

## Field 2—WATER CYCLE

### Group 2F—Groundwater

#### GROUND-WATER QUALITY STANDARDS--IRRELEVANT,

For primary bibliographic entry see Field 5B.  
W79-05125

#### LAND APPLICATION OF WASTE--AN ACCIDENT WAITING TO HAPPEN,

Pirnie (Malcolm) Inc., Silver Spring, MD.  
For primary bibliographic entry see Field 5B.  
W79-05126

#### THE FEDERAL GROUND-WATER PROTECTION PROGRAM--A REVIEW,

Environmental Protection Agency, Washington, DC. Office of Drinking Water.  
For primary bibliographic entry see Field 5G.  
W79-05127

#### THE FEDERAL GROUND-WATER PROTECTION PROGRAM--TODAY'S HOPE,

Environmental Protection Agency, Dallas, TX.  
For primary bibliographic entry see Field 5G.  
W79-05128

#### THE FEDERAL GROUND-WATER PROTECTION PROGRAM--TOMORROW'S UNDOING,

Wehran Engineering Corp., Middletown, NY.  
For primary bibliographic entry see Field 5G.  
W79-05129

#### STATE GROUND-WATER PROTECTION PROGRAMS--A NATIONAL SUMMARY,

Environmental Protection Agency, Chicago, IL. Region V.  
For primary bibliographic entry see Field 5G.  
W79-05130

#### STATE GROUND-WATER PROTECTION PROGRAMS--INADEQUATE,

Virginia State Water Control Board, Roanoke. West Central Regional Office.  
For primary bibliographic entry see Field 5G.  
W79-05131

#### STATE GROUND-WATER PROTECTION PROGRAMS--ADEQUATE,

Minnesota Dept. of Health, Minneapolis.  
For primary bibliographic entry see Field 5G.  
W79-05132

#### AN EXAMPLE OF THE USE OF FACTOR ANALYSIS AND CLUSTER ANALYSIS IN GROUNDWATER CHEMISTRY INTERPRETATION,

Birmingham Univ. (England). Dept. of Geological Sciences.  
R. P. Ashley, and J. W. Lloyd.  
Journal of Hydrology, Vol. 39, No. 3/4, p 355-364, December 1978. 5 fig, 12 ref.

Descriptors: \*Groundwater, \*Water chemistry, \*Analytical techniques, Statistics, Dissolved solids, Hardness(Water), Iron, Silica, Hydrogen ion concentration, Ions, Chemicals, Water quality, Hydrogeology, Chemistry, \*Factor analysis, \*Cluster analysis.

Factor analysis and cluster analysis, as applied to two widely differing sets of groundwater hydrochemical data, appear to be moderately successful as statistical tools for revealing hydrochemical and hydrogeological features, including patterns of groundwater flow. They possess advantages over the traditional graphical methods of solving similar problems, principally in their systematic nature, and they can generate inter-parameter relationships that may be overlooked in the less sophisticated traditional methods. Their disadvantages are that they are easily prone to misuse and misinterpretation due to their complexity. Further, there is a need for the user to have adequate statistical knowledge. (Sims-ISWS)  
W79-05143

#### GROUNDWATER LEVELS IN NEBRASKA, 1977,

Geological Survey, Lincoln, NE. Water Resources Div., and Nebraska Univ., Lincoln. Conservation and Survey Div.  
M. J. Ellis, and D. T. Pederson.  
Nebraska Water Survey Paper Number 45, December 1978. 96 p, 24 ref.

Descriptors: \*Groundwater resources, \*Water wells, \*Water levels, \*Water level fluctuations, \*Nebraska, Observation wells, Hydrographs, Well data, Aquifer characteristics, Hydrologic data.

This report summarizes the 1977 water-level changes in Nebraska on a statewide basis and by major areas where significant changes from estimated predevelopment levels have occurred. It describes the availability of data on water levels, provides information on changes in the water-level measurement program during the year, and summarizes data on the two major causes of water-level changes--precipitation and groundwater use. Changes in water levels are illustrated by hydrographs of 66 continuous-record wells for the period of record. (Woodard-USGS)  
W79-05150

#### SUMMARY APPRAISALS OF THE NATION'S GROUND-WATER RESOURCES--ALASKA,

Geological Survey, Anchorage, AL. Water Resources Div.  
C. Zenone, and G. S. Anderson.  
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, \$1.60. Geological Survey Professional Paper 813-P, 1978. 28 p, 13 fig, 4 tab, 77 ref.

Descriptors: \*Groundwater resources, \*Alaska, \*Groundwater availability, Aquifers, Water yield, Groundwater recharge, Surface-groundwater relationships, Hydrogeology, Water supply, Permafrost, Water pollution sources, Saline water intrusion, Coasts, Water quality, Evaluation.

Ground water is a large but virtually unexplored and undeveloped resource in Alaska. Perennially frozen ground (permafrost) influences the occurrence, movement and availability of ground water except in the southern and southeastern coastal areas of the State. The most extensive aquifers occur in alluvium of major river valleys such as the Yukon, Tanana, Kuskokwim and Susitna. Large amounts of ground water are also stored in glacial outwash aquifers in coastal basin and valley deposits at Anchorage, Kenai and Juneau. Individual wells yielding more than 1,000 gallons per minute have been developed in the Tanana River Valley, Cook Inlet lowland, and the coastal valleys at Seward and Juneau. Comparable yields should be possible in other areas that have similar hydrologic environments. Both recharge and discharge of the large alluvial aquifers are concentrated along stream channels. It is estimated that 25 percent of the total volume of streamflow in Alaska (exclusive of coastal areas) is contributed by ground-water discharge. (Woodard-USGS)  
W79-05153

#### SUMMARY APPRAISALS OF THE NATION'S GROUND-WATER RESOURCES--SOUTH ATLANTIC-GULF REGION,

Geological Survey, Phoenix, AZ. Water Resources Div.; Geological Survey, Jackson, MS. Water Resources Div.; and Geological Survey, Charleston, WV. Water Resources Div.  
D. J. Cederstrom, E. H. Boswell, and G. R. Tarver.

Available from Supt. of Documents, GPO, Washington, DC 20402, Price, \$1.80. Geological Survey Professional Paper 813-0, 1979. 35 p, 1979. 4 tab, 86 ref.

Descriptors: \*Groundwater resources, \*Groundwater availability, \*Water quality, \*Regional analysis, Water demand, Water supply, Water utilization, Aquifer characteristics, Conjunctive use, Evaluation, Alabama, Florida, Georgia, North Carolina, South Carolina, Virginia, \*South Atlantic-Gulf Region.

The 270,000 sq mi South Atlantic-Gulf Region has ground-water resources capable of a sustained yield of 286,000 (gal/d)/sq mi. About 10 percent of the region's supply will meet the projected ground-water requirement for the year 2020. Most of the region's ground water will be developed from the extensive sedimentary Coastal Plain aquifers. The most extensive and most productive aquifers are in Tertiary limestone, Cretaceous sand and gravel, and Miocene sand. Large supplies of ground water can be developed in some places in the Cumberland Plateau and Valley and Ridge Provinces. In the Piedmont and Blue Ridge Provinces ground water is available only in moderate quantities. Ground water of acceptable chemical and physical quality is available in more than 90 percent of the region and freshwater extends to depths of slightly more than 3,000 feet in some areas. Ground-water problems are not severe although large water-level declines have occurred in some heavily-pumped areas and there are some instances of contaminated aquifers. (Woodard-USGS)  
W79-05154

#### GEOHYDROLOGIC DATA FROM TWENTY-FOUR TEST HOLES DRILLED IN THE PICEANCE BASIN, RIO BLANCO COUNTY, COLORADO, 1975-76,

Geological Survey, Lakewood, CO. Water Resources Div.  
F. A. Welder, and G. J. Saulnier, Jr.  
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225 Paper copy \$20.75, microfiche \$3.50. Geological Survey open-file report 78-734, September 1978. 132 p, 73 fig, 31 tab, 21 ref.

Descriptors: \*Hydrogeology, \*Hydrologic data, \*Test wells, \*Water yield, \*Water quality, Aquifer characteristics, Oil shales, Geologic formations, Logging(Recording), Water analysis, Chemical analysis, Temperature, Potentiometric level, Saline water, Colorado, \*Piceance basin, Rio Blanco County.

Twenty-four test holes were drilled in the Piceance basin, northwestern Colorado, to obtain geohydrologic data from the Uinta and Green River Formations of Eocene age. Depths of test holes ranged from 640 to 2,800 feet. The maximum quantity of water discharged during the air drilling of individual test holes ranged from 14 to 880 gallons per minute. The specific conductance of water discharged during drilling ranged from 100 to 50,000 micromhos per centimeter at 25 degrees Celsius. Aquifer tests made during drilling indicate transmissivity at four sites ranged from 100 to 1,600 feet squared per day and the storage coefficient at two sites ranged from 0.0004 to 0.00016. Depths to the static water level ranged from 30 to 695 feet. Water levels were measured in each test well, and potentiometric maps constructed from these measurements are comparable in configuration and altitude to those previously drawn from composite-head data. Water samples taken during drilling indicate that, except for water from the Uinta Formation, the water in Piceance basin is generally not suited for domestic water supply due to the presence of excessive amounts of certain trace constituents, notably fluoride. The average concentration of dissolved solids, based on data from the test holes, was 909 milligrams per liter (mg/L) for the Uinta Formation, 828 mg/L for the upper part of the Parachute Creek Member of the Green River Formation, and 3,460 mg/L for the lower part of the Parachute Creek Member. (Woodard-USGS)  
W79-05164

### 2G. Water In Soils

#### THE DEVELOPMENT OF OVERLAND FLOW IN A TROPICAL RAINFOREST CATCHMENT,

James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Geology.  
For primary bibliographic entry see Field 2A.  
W79-05030

MODELING GLADES OF Agriculture, Glade, FL. S. F. Shih, Myhre. Transactional Engineering, November-1978.

Descriptor: \*Crops, \*models, \*table, \*Sugar Carbon, \*Agriculture.

A model introduced series applied when relation crop type controlled sugarcane pasture and for crop prediction. W79-05031

DRAINAGE FILE BY Idaho Univ. Engineering. M. J. Khan. Paper No. Meeting of Engineers, fig. 1 tab.

Descriptor: Computer, table, \*Series, \*So.

An agricultural soil element of a form of a between time. Content, conductivity, porosity) using a one results from distance. 7 not used above the Colorado. W79-05032

SUBSUN CLAY S4 Science Rouge, I. For primary W79-05033

INFLUENCE ON INF Pennsylvania of Agriculture. A. R. Jan. Paper No. Meeting of Engineers, fig. 22 ref.

Descriptor: age, Sub-face data.

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## Water In Soils—Group 2G

**MODELING THE SUBSIDENCE OF EVERGLADES ORGANIC SOIL**

Agricultural Research and Education Center, Belle Glade, FL.

S. F. Shih, J. W. Mishoe, J. W. Jones, and D. L. Myhre.

Transactions of the American Society of Agricultural Engineers, Vol. 21, No. 6, p 1151-1156, November-December 1978. 3 fig, 3 tab, 12 ref.

**Descriptors:** \*Subsidence, \*Land subsidence, \*Crops, \*Florida, \*Model studies, Mathematical models, Organic soils, Farm management, Water table, Sugarcane, Vegetable crops, Pastures, Soils, Carbon, Soil water, Crop production, Soil science, Agriculture, Everglades organic soils.

A model related to the subsidence of histosols was introduced. The model was expanded by a power series approximation, and the coefficients of the series were obtained by using the multiple regression analysis technique. The results of the model when related to the water table with three different crop types showed that if the water tables were controlled at similar depths, the subsidence rate in sugarcane fields is about 30% less than in fields of pasture and truck crops. The model can be applied for crop period adjustment, annual subsidence rate prediction, and crop selection. (Sims-ISWS) W79-05037

**DRAINAGE IN A NATURAL LAYERED PROFILE BY FINITE ELEMENT ANALYSIS**

Idaho Univ., Moscow. Dept. of Agricultural Engineering.

M. J. Khanjani, and G. L. Bloomsburg.

Paper No. 78-2036, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 18 p. 8 fig, 1 tab, 5 ref. ASAE, St. Joseph, Michigan.

**Descriptors:** \*Drainage, Finite element analysis, Computer programs, Subsurface drains, Water table, Porosity, Hydraulic conductivity, Soil properties, \*Soil profiles, Pore pressure.

An agricultural soil profile consisting of four different soil types is modeled by means of a finite element computer program. The results are in the form of a curve for water table height at midpoint between drains versus dimensionless function of time. Composite values for soil properties (apparent, conductivity, displacement head, and drainage porosity) are calculated, and the result from running a one layer composite profile are compared to results from an actual profile. The effect of drain distance above the impermeable layer is also investigated. The Dupuit-Forchheimer assumptions are not used in this analysis and unsaturated flow above the water table is considered. (Skogerboe-Colorado State) W79-05051

**SUBSURFACE DRAINAGE OF AN ALLUVIAL CLAY SOIL FOR SOYBEANS**

Science and Education Administration, Baton Rouge, LA.

For primary bibliographic entry see Field 4B.

W79-05053

**INFLUENCE OF SOIL AIR AND DRAINAGE ON INFILTRATION**

Pennsylvania State Univ., University Park. Dept. of Agricultural Engineering.

A. R. Jarrett, J. R. Hoover, and C. L. Davis.

Paper No. 78-2039, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 8 p. 7 fig, 22 ref. ASAE, St. Joseph, Michigan.

**Descriptors:** \*Infiltration, Infiltration rates, Drainage, Subsurface drainage, Rainfall, Runoff, Subsurface drains, Surface runoff, Laboratory tests.

The effect of soil air entrapment and subsurface drainage in a sand were evaluated. During rainfall, the entrapped soil air pressure stopped the infiltration process converting all precipitation to runoff except when the entrapped air was permitted to

vent via the subsurface drain, at which time infiltration and subsurface drainage started and runoff ceased. (Skogerboe-Colorado State) W79-05054

**A SIMPLE FINITE ELEMENT METHOD OF INFILTRATION**

Pennsylvania State Univ., University Park. Dept. of Agricultural Engineering.

R. Pall, A. R. Jarrett, and C. T. Morrow.

Paper No. 78-2068, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 10 p. 14 fig, 12 ref. ASAE, St. Joseph, Michigan.

**Descriptors:** Infiltration, \*Infiltration rates, \*Soil water movement, Numerical analysis, Finite element analysis, Darcy's law, Diffusivity, Computer models.

A numerical solution of one dimensional infiltration was developed from basic principles of flow and energy conservation using finite element technique. An exponential relationship between hydraulic diffusivity and volumetric moisture content was used for diffusivity calculations. Solutions obtained for horizontal moisture distribution gave an excellent agreement with exact solution of Scott et al. (1962) and numerical solutions of Philip (1955) and Hanks and Bowers (1962). (Skogerboe-Colorado State) W79-05064

**PREDICTING DISPERSION COEFFICIENTS IN SOILS**

Florida Univ., Gainesville.

A. G. Smajstrla, D. L. Reddell, and P. L. Barnes.

Paper No. 78-2074, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 16 p. 16 fig, 18 ref. ASAE, St. Joseph, Michigan.

**Descriptors:** \*Dispersion, Soil physics, Numerical analysis, \*Soil water movement, Capillary water, Diffusion, Simulation analysis, Model studies, Computer models.

A numerical model was developed to predict the magnitudes of dispersion coefficients as functions of soil physical and hydrologic properties and solution velocities. A capillary bundle model was used, and the bundle hydraulic properties were determined from the hydraulic conductivity function. Interaction between bundles was described as a diffusion-controlled process. The model generated breakthrough curves from simulated steady flow displacement of one soil solution with a second one. From the breakthrough curves, dispersion coefficients were calculated. The breakthrough curves and dispersion coefficients were compared with those measured in the laboratory with good agreement for unsaturated flow conditions and for saturated flow at low velocities. Agreement during saturated flow at large velocities was only obtained when a matching factor was used to describe mixing between capillary bundles. (Skogerboe-Colorado State) W79-05067

**MODELING NITROGEN MOVEMENT IN AGRICULTURAL WATERSHEDS**

Florida Univ., Gainesville. Dept. of Agricultural Engineering.

K. L. Campbell, and G. Sinai.

Paper No. 78-2071, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 15 p. 1 fig, 22 ref. ASAE, St. Joseph, Michigan.

**Descriptors:** \*Nitrogen, Water quality, Model studies, Simulation analysis, Pollutants, Pollution abatement, \*Agricultural watersheds, Hydrology, Nutrient removal.

Techniques were developed to simulate nitrogen movement through agricultural watersheds. The USDAHL-74 (USDA-ARS Tech. Bul. No. 1518) model of watershed hydrology was used to provide the hydrologic information required to model

nitrogen movement. The ACTMO (agricultural chemical transport model, USDA, ARS-H-3) nitrates model was used as a framework for the nitrogen model. Important components to be added to the ACTMO model are discussed. (Skogerboe-Colorado State) W79-05069

**VARIABILITY OF SOIL WATER RETENTION CURVES AND PREDICTED HYDRAULIC CONDUCTIVITIES ON A SMALL PLOT**

Department of Agriculture, Swift Current (Saskatchewan). Research Station.

D. R. Cameron.

Soil Science, Vol. 126, No. 6, p 364-371, December 1978. 3 fig, 4 tab, 19 ref.

**Descriptors:** \*Hydraulic conductivity, \*Soil water, \*Retention, Moisture tension, Curves, Cores, Soil physical properties, Bulk density, Depth, Drying, Soil texture, Soil water movement, Clay loam soils.

Soil water retention curves were measured on cores taken from five sites at six depths in a Bainsville clay loam soil. There were differences in both the shape and magnitude of the average moisture characteristic curves from one location to another in the 225 sq m plot. Coefficients of variation ranged from 4.2 to 13% in the surface layers and from 2.4 to 6.5% in the deeper layers. There were no consistent trends in variability with respect to tensions from 0 to -500 cm H<sub>2</sub>O. Predicted and measured hydraulic conductivity functions were variable, often showing a 100-fold difference at a given water content. The measured K functions were steeper than those predicted, and the match between them was considered reasonable only at the lower water contents. (Visocky-ISWS) W79-05136

**DRAINAGE RATES AND WATER-TABLE DEPTHS**

Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.

S.-T. Chiang, R. S. Broughton, and N. Foroud.

Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 104, No. 1R4, Proceedings Paper 14260, p 143-153, December 1978. 8 fig, 8 tab, 8 ref, 2 append.

**Descriptors:** \*Drainage, \*Drainage patterns, \*Water table, \*Depth, Evapotranspiration, Porosity, Precipitation (Atmospheric), Water balance, Soil moisture, Drains, Unsteady flow, Frequency analysis, Statistical methods, Statistical models, Drainage rate.

Precipitation and evapotranspiration data for 27 years from three stations in the Ottawa and St. Lawrence Lowlands were used together with a hydrologic model of the drainage process to obtain the duration of particular water table heights to be expected. An IBM 370/158 computer was used to make day-by-day calculations of the expected water table heights for a range of conditions including drainage coefficients from 3 mm/day to 15 mm/day; drain depths of 1 m, 1.4 m, and 1.8 m; drainable porosities from 0.03 to 0.11; and available soil moisture in the root zone from 60 mm to 151 mm. A statistical frequency analysis of the output was made. The results from these computations were prepared in tabular and graphical form to show the effect of drainage rate on water table height. By using a criterion for the number of days the water table may be at or less than a particular depth, a design drainage rate can be selected. (Visocky-ISWS) W79-05137

**ERRORS IN GAMMA-RAY MEASUREMENTS OF WATER CONTENT AND BULK DENSITY IN NONUNIFORM SOILS**

Oklahoma State Univ., Stillwater. Dept. of Agronomy.

D. L. Nofziger.

Soil Science Society of America Journal, Vol. 42, No. 6, p 845-850, November-December 1978. 7 fig, 1 tab, 6 ref.

## Field 2—WATER CYCLE

### Group 2G—Water In Soils

**Descriptors:** \*Moisture content, \*Bulk density, \*Soil physical properties, \*Gamma rays, Nuclear moisture meters, Measurement, Infiltration, Expansive clays, Freezing, Heterogeneity, Stratification, Stratified soil, Dual gamma-ray attenuation.

Recent experimental study of freezing soils has shown that gamma-ray measurements of water content and bulk density are in error when the water content and bulk density are not uniform throughout the gamma-ray beam. Errors in gamma-ray water content and bulk density were determined for soil water systems with linear and step-function changes in water content and bulk density and for measurements of water absorption by a non-swelling porous medium. Both single-energy and dual-energy gamma-ray measurements can occur for highly stratified soils. The calculated values may fall outside the range of values within a gamma-ray beam. Relatively small errors occur if bulk density and water content change linearly in the collimated beam. Both single- and dual-energy systems accurately measure the average water content in the collimated beam if the bulk density of the soil is constant. However, the average water content in the beam may not represent the water content at the middle of the collimated beam and the middle of the preset time period. Errors due to nonuniform soils can be evaluated using the equations and graphs presented. (Visocky-ISWS)

W79-05251

#### OBTAINING VARIATIONS OF FIELD INFILTRATION CAPACITY FROM SIMULATED RAINSTORM EXPERIMENTS (DETERMINATION DES VARIATIONS DE LA CAPACITE D'ABSORPTION D'UN SOL EN PLACE SOUS AVERSES SIMULEES)

Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France). Hydrology Section. A. Lafforgue.

Hydrological Sciences Bulletin, Vol. 23, No. 3, p 355-372, September 1978. 9 fig, 1 tab, 2 ref.

**Descriptors:** \*Runoff, \*Infiltration, \*Soil water, \*Model studies, Simulated rainfall, Laboratory tests, Hydraulic models, Soil moisture, Storage, Analytical techniques, Analysis, Mathematical models, Infiltration rates, Retention, Storage capacity, Rainfall-runoff relationships, Soil water movement, Moisture content, Foreign research, \*France.

By sprinkling an experimental plot with different intensities of simulated rainfall starting with different initial conditions of soil moisture, the variations of infiltration capacity, and consequently the response of the soil surface to runoff, were evaluated. The following values were determined successively from experimental data: the mean depth of surface storage, the mean depth of detention, and the parameters of a chosen infiltration formula. (Humphreys-ISWS)

W79-05257

#### THE APPLICABILITY OF DUAL GAMMA SCANNING TO FREEZING SOILS AND THE PROBLEM OF STRATIFICATION

Guelph Univ. (Ontario). Dept. of Land Resource Science.

For primary bibliographic entry see Field 2C. W79-05260

**LATERALLY CONFINED FLOW FROM A POINT SOURCE AT THE SURFACE OF AN INHOMOGENEOUS SOIL COLUMN**, Science and Education Administration, Mandan, MD. Northern Great Plains Research Center. S. D. Merrill, P. A. C. Raats, and C. Dirksen. Soil Science Society of America Journal, Vol. 42, No. 6, p 851-857, November-December 1978. 8 fig, 18 ref.

**Descriptors:** \*Confined water, \*Heterogeneity, \*Soils, \*Model studies, \*Infiltration, Hydraulic conductivity, Irrigation, Mathematical models,

Equations, Theoretical analysis, Pressure head, Measurement, Soil water movement, Flow, Point source, Drip irrigation, Trickle irrigation, Lateral flow.

Solution of a linearized flow equation for steady, axisymmetric, laterally confined infiltration from a point source located at the soil surface was compared with pressure head patterns measured in an undisturbed column of sandy loam. The geometry approximates an array of trickle irrigation emitters. The hydraulic conductivity could be represented as an exponential function of both the pressure head and the depth in the column. This implies that steady, multidimensional flow in the column is described by a linear flow equation. Measured and predicted distributions of pressure head agreed most closely at an application rate of 0.5 cm/day. Increase in the size of a saturated zone about the point source at application rates higher than 0.5 cm/day caused isolines of pressure head to be distorted from the predicted shape. Flow patterns for homogeneous and heterogeneous soil were compared. Trickle irrigation systems usually are operated intermittently. Measured distributions of pressure heads under intermittent application were compared with steady infiltration patterns. A steady-flow solution will give an approximate prediction of intermittent pressure head patterns for continuously repeated application cycles over part of the flow region and during part of the time. (Visocky-ISWS)

W79-05261

#### APPLICATION OF STRAW IN AGRICULTURE IN THE ARID STEPPE ZONE OF THE NORTHERN KAZAKH SSR (IN RUSSIAN), Tselinograd Agricultural Inst. (USSR). N. I. Kanivets, and V. A. Fomin. Izv Akad Nauk Sssr Ser Biol (4) p 534-540. 1977. (English summary).

**Descriptors:** \*Mulching, \*Crop response, USSR, Wheat.

The effect of mulching with straw on microbiological properties, humidity and nutritional conditions of the soil and on the yield of summer wheat on dark-chestnut soils of the Tselinograd region (USSR) was studied. Mulching enhanced the soil microbiological activity, improved water and thermal conditions and promoted phosphate availability, resulting in increased yields. Copyright 1978, Biological Abstracts, Inc.

W79-05343

## 2H. Lakes

#### MATHEMATICAL MODELING OF SURFACE WATER IMPOUNDMENTS, VOLUME I, AND II,

Resource Management Associates, Lafayette, CA. G. T. Orlieb.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 204. Price codes: A16 in paper copy, A01 in microfiche. Report, 1977. 2 volumes, 354 p, 13 fig, 1 tab, 440 ref, 3 append. OWRT T-0006(6706)(1).

**Descriptors:** \*Impoundments, \*Lakes, \*Reservoirs, \*Mathematical models, Simulation, Optimization, Stratified flow, Hydrodynamics, Stochastic processes, Linear programming, Dynamic programming, Lake Erie, Lake Ontario, Lake Washington, Fontana Reservoir.

A review of the state-of-the-art of mathematical modeling of surface water impoundments was conducted. Models reviewed included one-dimensional models for simulation of temperature and water quality in stratified reservoirs, two-dimensional circulation and water quality in shallow lakes, two-dimensional stratified flow, circulation in multi-layer large lakes, and eutrophication and ecological responses in lake systems. Model for simulation/optimization of single reservoir and multiple reservoir systems were also reviewed, including LP, DP, explicit and implicit stochastic methods, and simulation techniques. Recommendations are

made for the formation of a 'national register' of software for water resource planning and management, with functions of facilitating technology transfer, standardizing documentation procedures, and disseminating information on mathematical models to potential users.

W79-05011

#### AN EVENT-BASED STOCHASTIC MODEL OF PHOSPHORUS LOADING INTO A LAKE, Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering and Arizona Univ., Tucson. Dept. of Hydrology and Water Resources. For primary bibliographic entry see Field 5B. W79-05021

#### SIZING OF RESERVOIRS FOR PERIODIC-STOCHASTIC INPUT AND PERIODIC OUTPUT, Engineering Consultants, Inc., Denver, CO. K. N. Mutreja, and V. Yevjevich. Journal of Hydrology, Vol. 39, No. 3/4, p 323-338, December 1978. 7 fig, 3 tab, 13 ref. NSF ENG74-17396.

**Descriptors:** \*Reservoirs, \*Storage capacity, \*Model studies, Mathematical models, Stochastic processes, Analytical techniques, Storage, Flow, Rivers, Streamflow, Regulated flow, Inflow, Discharge(Water), Water supply, Hydrology.

A method was presented for designing the capacities of large storage reservoirs with relatively high levels of regulation by using the mass curve and the maximum deficit rather than the range of the short-interval flows such as the daily flows. These reservoir inputs were composed of periodic parameters and stochastic components. The output was a deterministic process, either constant or periodic. Both the analytical and the data generation methods were used for computing the required storage capacities and for regulating the periodic-stochastic inputs to deterministic outputs. The mean required storage capacity was designated as the total storage. The total storage was defined as the expected maximum deficit of the net input to a reservoir. It was divided into the difference storage and the stochastic storage, with the total storage equal to the difference storage plus the stochastic storage. Difference storage is needed because of the periodic means of input and output. It is approximately constant for large samples, and can be estimated for different sample sizes by generating the relatively short series of daily flows. Stochastic storage is defined as the expected maximum deficit of the stochastic net input. It was computed analytically by using a coefficient estimated from the generated short series of daily flows. The method presented for the determination of the total storage by its decomposition into the difference storage and the stochastic storage was applied to a case study in determining the storage capacity of a reservoir with the economic life of 100 years, to be constructed as a site for which 40 years of daily flows are available (the Oconto River, near Gillet, Wisconsin). (Sims-ISWS)

W79-05029

#### MATHEMATICAL MODELING OF SEDIMENT DEPOSITION IN RESERVOIRS, Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

For primary bibliographic entry see Field 2J. W79-05142

**EXPECTED ASYMPTOTIC MAXIMUM DEFICIT FOR PERIODIC-STOCHASTIC RESERVOIR INFLOWS IN CASE OF PARTIAL FLOW REGULATION**, Engineering Consultants, Inc., Denver, CO. K. N. Mutreja, and V. Yevjevich. Journal of Hydrology, Vol. 39, No. 3/4, p 311-321, December 1978. 3 fig, 3 tab, 5 ref. NSF ENG74-17396.

**Descriptors:** \*Reservoirs, \*Storage capacity, \*Regulated flow, \*Model studies, Mathematical models, Inflow, Discharge(Water), Water supply, Flow,

Storage, Stochastic processes, Hydrology.

So far, no explicit method for determining the reservoir deficit has been available. The reasons for this are: (1) the method for determining the deficit is based on the case of full flow; (2) the method for determining the deficit is based on the case of full flow; (3) the method for determining the deficit is based on the case of full flow; (4) the method for determining the deficit is based on the case of full flow; (5) the method for determining the deficit is based on the case of full flow; (6) the method for determining the deficit is based on the case of full flow; (7) the method for determining the deficit is based on the case of full flow; (8) the method for determining the deficit is based on the case of full flow; (9) the method for determining the deficit is based on the case of full flow; (10) the method for determining the deficit is based on the case of full flow; (11) the method for determining the deficit is based on the case of full flow; (12) the method for determining the deficit is based on the case of full flow; (13) the method for determining the deficit is based on the case of full flow; 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## Water In Plants—Group 21

Storage, Stochastic processes, Analytical techniques, Hydrology.

So far, no exact expression analytically derived is available for the expected asymptotic maximum reservoir deficit of periodic-stochastic net inflows. The reasons are in the complexities involved. A method for obtaining this maximum deficit for the case of full flow regulation has been presented in another paper. This paper treated the case of partial flow regulation. The storage required by the periodicity in the mean was added to the expected asymptotic maximum deficit of the stochastic component of net input to reservoir. The storage required by the periodicity in the mean was approximated by a constant. The same approach is also valid for the partial flow regulation. (See also W78-02791) (Sims-ISWS)  
W79-05145

# CHARACTERISTICS OF PENNSYLVANIA RECREATIONAL LAKES,

Geological Survey, Harrisburg, PA. Water Resources Div.

J. L. Barker.

Pennsylvania Department of Environmental Resources Bulletin No 14, April 1978. 226 p, 24 ref, append.

Descriptors: \*Limnology, \*Pennsylvania, \*Lakes, \*Impoundments, \*Water quality, Eutrophication, Nutrients, Pesticides, Plankton, Dissolved solids, Chemical properties, Biological properties, Freshwater, Thermocline, Epilimnion, Hypolimnion, Mixing, Recreational lakes.

Limnological surveys of 53 multiple-use impoundments throughout Pennsylvania were conducted during July and August from 1971 through 1975. The lakes ranged in size from 4 acres to 14,500 acres and represent a cross section of the chemical and trophic types found in Pennsylvania. Temperature and oxygen profiles indicate that nearly all impoundments having depths greater than 19.7 feet become stratified thermally and chemically. The deeper lakes with longer residence time generally develop a higher degree of thermal stability. Dissolved oxygen supersaturation in the epilimnion and depletion in the metalimnion and hypolimnion is common in many lakes during the summer stagnation. The stratified impoundments 'turn-over' or mix during the spring and autumn and are, therefore, classified as dimictic. The dissolved solids concentrations of lakes range from about 17 to 130 milligrams per liter, in the absence of mine drainage or other pollutants. The general sources of dissolved solids, in descending order of significance, were weathered carbonate rocks, unconsolidated water-sorted sediment, igneous and metamorphic rocks, noncarbonate sedimentary rocks, and glacial drift. Each lake is described with a map, a list of physical and morphological features, a brief discussion of water quality and biological characteristics, temperature and dissolved oxygen profiles, and tabulated basic data. The basic data include chemical analyses for the common constituents, trace metals, and pesticides. Lists of the major plankters and hydrophytes are included as well as an estimate of their relative abundance. (Woodard-USGS)  
W79-05168

# MITIGATING ADVERSE ENVIRONMENTAL EFFECTS OF HIGHWAY CONSTRUCTION.

For primary bibliographic entry see Field 6G.  
W79-05235

# INTERNAL WAVES IN A CIRCULAR CHANNEL,

Michigan Univ., Ann Arbor. Dept. of Applied Mechanics and Engineering Science.  
W. H. Yang, and C-S. Yih.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-034 331. Price codes: A02 in paper copy, A01 in microfiche. Journal of Fluid Mechanics, Vol. 74, Pt. 1, p 183-192, December 31, 1976. 3 fig, 8 ref.

Descriptors: \*Waves(Water), \*Theoretical analysis, \*Frequency, Analysis, Stratification, Lakes, Channels, Equations, Mathematics, Flow. \*Wave modes.

The frequencies of the first four sloshing internal wave modes in two superposed fluid layers contained in a circular channel were calculated for two positions of the free surface and for various ratios of the depths of the two layers. Flow patterns were given for the first four sloshing modes for the case in which the fluids occupy a semicircular space and the depth of the upper layer is 1/4 of the radius. The results obtained provide a guide for estimating the frequencies of sloshing internal wave modes in long lakes. (Adams-ISWS)  
W79-05250

# COMPARISON THEOREMS FOR GRAVITY WAVES IN BASINS OF VARIABLE DEPTH,

Michigan Univ., Ann Arbor.

C-S. Yih.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-034 330. Price codes: A02 in paper copy, A01 in microfiche. Quarterly of Applied Mathematics, Vol. 33, p 387-394, January 1976. 1 fig, 3 ref.

Descriptors: \*Waves(Water), \*Theoretical analysis, \*Frequency, Analysis mathematics, Stratification, Lakes, Equations, Basins, Model studies. \*Comparisons, Two-layer models.

Surface waves of a homogeneous liquid and internal waves of a stratified liquid in basins of variable depth were considered. Inequalities involving the frequencies of oscillation are obtained when a container with one size or geometry is compared with another of a different size or geometry, when waves with one wavelength are compared with waves of another wavelength, or when one stratification is compared with another. Since exact solutions for gravity waves in basins of variable depth are so rare, the comparison theorems presented herein will be useful. (Adams-ISWS)  
W79-05253

# A TIME-DEPENDENT MODEL OF A COASTAL BOUNDARY LAYER WITH FRICTION,

Northwestern Univ., Evanston, IL. Dept. of Geological Sciences; and Northwestern Univ., Evanston, IL. Dept. of Engineering Sciences and Applied Mathematics.

G. E. Birchfield, and A. T. Lunde.

Journal of Geophysical Research, Vol. 83, No. C12, p 6155-6162, December 20, 1978. 4 fig, 2 tab, 7 ref, append.

Descriptors: \*Boundary layers, \*Lakes, \*Fluid friction, \*Model studies, \*Great Lakes, Mathematical models, Winds, Currents(Water), Water circulation, Waves(Water), Coasts, Mathematics, Equations, Limnology, Coastal boundary layers.

The time-dependent development of a coastal frictional boundary layer forced by a wind stress impulse was investigated. Although because of mathematical nonuniformities in space and time a solution was found which was restricted to an inner region dominated by bottom friction, some details of the coastal response were found. In the context of a coastal response of a lake of the size of Lake Ontario, it was found that maximum surface displacements of several centimeters occur in the left upwind and right downwind quadrants of the basin. In the adjustment to steady-state, the displacements propagate counterclockwise around the coastal region. The coastal jets with maxima in the same quadrants do not move significant distances in the approach to steady-state. Several aspects of the model appeared in a forced response observed on the south shore of Lake Ontario. (Sims-ISWS)  
W79-05263

# A MATHEMATICAL MODEL FOR PREDICTING RIVER TEMPERATURES—APPLICATION TO THE GREEN RIVER BELOW FLAMING GORGE DAM,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.

J. J. Sartoris.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-259 989. Price codes: A03 in paper copy, A01 in microfiche. REC-ERC-76-7. Engineering and Research Center, Bureau of Reclamation, Denver, CO., April 1976. 28 p, 6 fig, 6 tab, 10 ref, 4 append.

Descriptors: \*Rivers, \*Mathematical models, \*Water temperature, \*Selective level releases, Fish, Conservation, Computer programs, Multilevel lakes, Temperature control, Simulation analysis, Computer models, Fisheries, Dams, Evaluation, Empirical equations, Green River(Utah-Col.), Flaming Gorge Reservoir(Utah-Wyoming), Systems analysis.

The purpose of this study was to evaluate the effect of selective withdrawal modifications at Flaming Gorge Dam on temperatures in the Green River downstream. A computerized mathematical temperature model, incorporating the conservation of heat equation and an equilibrium temperature approach to heat exchange, was developed for this purpose. The model was calibrated, using 1974 average daily meteorological and hydrological data, to observed temperatures at three river stations, covering a total distance below the dam of 70.0 kilometres (43.5 river miles). The average monthly error between predicted and observed mean daily river temperatures at these stations ranged from 0 to 1.2C (0 to -2.2F). The calibrated model was used to simulate river temperatures for the case of only two penstock intake structures modified for selective withdrawal and for all three intakes modified. Simulation results indicate that, while the two-intake modification strategy would result in river temperatures significantly nearer the optimum fishery range than those recorded in 1974, operation with all three intakes modified would generally result in optimum fishery temperatures from May through September. The computer model developed in this study could be adapted to a variety of data and stream conditions. (Bell-Graf-Cornell)  
W79-05283

## 21. Water In Plants

### PLANT NUTRIENT LOSSES FROM FOLIAR FERTILIZED SOYBEANS,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 5G.  
W79-05056

### INFLUENCE OF ROW SPACING OF GRAIN SORGHUM ON GROUND COVER, RUNOFF, AND EROSION,

Science and Education Administration, Temple, TX. Grassland, Soil and Water Research Lab.  
For primary bibliographic entry see Field 3F.  
W79-05258

### REACTION OF SOYBEANS TO OVERFLOODING OF SOIL, (IN RUSSIAN),

Far East State Univ., Vladivostok (USSR).  
V. E. Kosmakova, A. F. Skripchenko, L. T. Prozumenshchikova, N. S. Nikonova, and E. A. Belyavskaya.  
S-Kh Biol Vol. 10, No. 3, p 359-363. 1975. (English summary).

Descriptors: \*Flooding, \*Crop response, \*Soybeans.

Metabolism in soybean plants is greatly disturbed after 5-7 days of flooding of soil: respiration becomes stronger in leaves, content of nucleic acids and protein decreases, and composition of organic acids changes. If the flooding is prolonged the intensity of respiration in roots falls to zero and the nucleic acid content decreases. The photosynthesis of turgescence leaves remains the same but the release of assimilates from them slows down. The intake of assimilates by roots is inhibited. Under

### Group 21—Water In Plants

**GROWTH RHYTHMS OF WHEAT VEGETATIVE ORGANS AND THE EFFECT OF DROUGHT ON THEM (IN RUSSIAN),**  
Akademika Nauk Kazakhskoi SSR, Alma-Ata.

A study of the daytime water state, relative turgor resistance and water retaining capacity of leaves in 6 grape cultivars introduced into the hot, dry climate of southern Turkmen SSR (USSR) indicated considerable variations in the first 2 categories during the delay in the summer, in direct correlation with the pressure of meteorological factors. Restoration of turgor after water saturation was proportional to the extent of water loss during wilting, and was not related to the degree of variation of their water state or their relative turgor resistance during the course of the day. Copyright 1978, Biological Abstracts, Inc. W79-05342

**Rangeland hydrology and sedimentation studies on a main stem and three source watersheds within the Reynolds Creek Experimental Watershed showed a wide range in precipitation, runoff, sediment transport, sediment yield, and particle-size characteristics from year to year and from station to station. Results are useful to provide data in rangeland erosion and sediment models. (Sims-ISWS)**  
W79-05035

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## Erosion and Sedimentation—Group 2J

# SOIL EROSION AND SEDIMENT MOVEMENT UNDER SUGARCANE CULTURE ON THE FLAT LANDS OF SOUTHERN LOUISIANA

Southern Piedmont Conservation Research Center, Watkinsville, GA.  
A. P. Barnett, A. E. Dooley, and G. A. Smith.  
Transactions of the American Society of Agricultural Engineers, Vol. 21, No. 6, p 1144-1150, 1156, November-December 1978. 2 fig, 7 tab, 25 ref.

Descriptors: \*Soils, \*Soil erosion, \*Simulated rainfall, \*Louisiana, On-site investigations, Crops, Sugarcane, Runoff, Erosion, Sediments, Sediment transport, Soil types, Farm management, Ditches, Sedimentation, Water quality, Soil science, Agriculture.

Commerce and Sharkey soils were found to be highly erodible. Simulated rainfall tests resulted in soil erodibility factors (K) of 0.63 and 0.44, respectively, for Commerce and Sharkey soils; metric K's were 0.81 and 0.57. A cropping factor for a conventional four-year sugarcane cropping system was found to be 0.41. Soil erodibility factors derived from field data were compared with those determined with the Wischmeier nomograph. Due to good aggregation and aggregate stability, these silt loam and silty clay soils were found to have apparent sandy loam surface textures, and to behave more like sandy loam than like silt and clay soils during the erosion process. (Sims-ISWS)  
W79-05038

# SEDIMENTATION MODELING OF IMPOUNDMENT TERRACES

Science and Education Administration, Ames, IA, North Central Region.  
J. M. Laflen, H. P. Johnson, and R. O. Hartwig.  
Transactions of the American Society of Agricultural Engineers, Vol. 21, No. 6, p 1131-1135, November-December 1978. 5 fig, 3 tab, 8 ref.

Descriptors: \*Soil erosion, \*Sediments, \*Terracing, \*Impoundments, Sedimentation, Model studies, Mathematical models, On-site investigations, Particle size, Soils, Soil science, Agriculture, Impoundment terraces.

A simulation model for predicting sediment concentration in water discharged from impoundment terraces was described. The model was based on the assumption that sediment concentration of the discharge water equals that of the water at the bottom of the impoundment near the outlet. Stoke's law was used to compute fall velocity of sediments suspended in the impoundment. Sediment concentration at the bottom of the pondage area is based on fall velocities of sediment, initial sediment concentration, initial sediment-size distribution, and the existence of an initial homogeneous sediment-water mixture within the impoundment. Sediment concentration in discharge from a single impoundment was predicted with acceptable accuracy. Under limited field testing, the model gave valid results. (Sims-ISWS)  
W79-05039

# CHARACTERIZATION OF RILL AND INTER-RILL ERODED SOIL

Science and Education Administration, Morris, MN, North Central Soil Conservation Research Center.  
R. A. Young, and C. A. Onstad.  
Transactions of the American Society of Agricultural Engineers, Vol. 21, No. 6, p 1126-1130, November-December 1978. 5 fig, 4 tab, 25 ref.

Descriptors: \*Soil erosion, \*Sediments, \*Laboratory tests, Soils, Soil types, Rill erosion, Erosion, Simulated rainfall, Particle size, Aggregates, Runoff, Soil science, Eroded soil, Interrill erosion.

Three soils were subjected to simulated rainfall to induce runoff and soil loss from 1.52- by 4.52-m laboratory plots with preformed rills. Soil loss was separated into that originating in the rill and that in interrill areas. The relative amounts of rill- and interrill-eroded soil were related to soil aggregation, aggregate stability, soil organic matter con-

tent, and particle-size distribution. Soil with a high degree of aggregation and relatively water-stable aggregates was less susceptible to interrill erosion (erosion by raindrop) than was more poorly aggregated soil. However, soil loss in organic matter was much more susceptible to rill erosion (erosion from flowing water). Also, the degree of slope tended to affect the source of the eroded material with the interrill areas providing an increasingly larger percentage of the total soil loss as the degree of slope increased. (Sims-ISWS)  
W79-05040

# EROSION SIMULATION FOR LAND USE MANAGEMENT

Science and Education Administration, Oxford, MS, Sedimentation Lab.  
D. G. DeCoursey.  
Paper No. 78-2082, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 18 p, 6 fig, 8 tab, ASAE, St. Joseph, Michigan.

Descriptors: \*Soil erosion, Erosion, Simulation analysis, Runoff, Surface runoff, Sediment yield, Hydrographs, Land management, \*Land use, Cotton.

In May, 1976, a paper entitled 'Philosophy of Erosion Simulation for Land Use Management' by D. G. DeCoursey and L. D. Meyer was presented at a Soil Erosion Workshop at Purdue University. The paper described schematically, a concept for combining hydrology, infiltration, moisture redistribution, crop growth, and rill-interrill erosion models to produce a dynamic simulation system that can be assembled to evaluate the environmental impact of land management alternatives. Most of the parameters are based on measurable factors or field tests. This paper describes such a simulation system and the data necessary to use it. Data from a cotton field in the Mississippi Delta were used to test and refine the system. Examples showing how the system can be used to evaluate alternative land management schemes are presented. Output from the system includes runoff, sediment, and cotton production. They were used to show how factors such as plant population fertilizer, row spacing, land slope and tillage operations can affect management alternatives. (Skogerboe-Colorado State)  
W79-05055

# REDUCING STREAM SEDIMENT LOADS BY IRRIGATION DIVERSIONS

Science and Education Administration, Boise, ID, Northwest Watershed Research Center.  
C. W. Johnson, and J. P. Smith.  
Paper No. 78-2088, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 14 p, 4 fig, 4 tab, 11 ref. ASAE, St. Joseph, Michigan.

Descriptors: Sediment control, \*Sediment load, Sediment discharge, Soil erosion, Streamflow, Diversion, Diversion structures, \*Irrigation effects, Idaho.

A streamflow, irrigation diversion, and suspended sediment study on the Reynolds Creek Experimental Watershed in southwest Idaho shows the effectiveness of an irrigation system in reducing downstream sediment loads. About 560 tonnes of sediment per year was deposited on 690 ha of pasture, hay, and grain cropland, an average deposition of 0.08 mm per year. The sediment from natural streamflow is usually beneficial to crop production in this mountain valley. (Skogerboe-Colorado State)  
W79-05057

# EXCAVATED SEDIMENT TRAPS -- WHAT RALPH WALDO EMERSON WAS REALLY TALKING ABOUT

C. P. Tryon, B. L. Parsons, and M. R. Miller.  
Paper No. 78-2089, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 10 p, 9 ref. ASAE, St. Joseph, Michigan.

Descriptors: Sediment control, \*Sediment load, Soil erosion, \*Detention reservoirs, Erosion, Cost comparisons, Comparative costs, Missouri.

A decade of experience on large earth moving jobs in the Missouri Ozarks has shown that excavated sediment traps are incomparably superior to small detention dams in terms of cost, industry acceptance, and sediment trap efficiency. (Skogerboe-Colorado State)  
W79-05058

# SEDROUTE PROCEDURE FOR ESTIMATING EROSION AND SEDIMENT IMPACTS

G. D. Kelly.  
Paper No. 78-2081, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 7 p, 4 ref. ASAE, St. Joseph, Michigan.

Descriptors: \*Sediment yield, \*Surface runoff, Runoff, Model studies, Sediment load, Mining, Sediment control, Idaho.

The SEDROUTE procedure predicts the amount and charge in erosion and sediment yield that will occur from a proposed project. The model uses a minimum of data and responds to changing project details. Impacts are routed downstream to show the effects of other water and sediment sources. (Skogerboe-Colorado State)  
W79-05066

# SEA RESEARCH PROGRAM FOR CHANNEL STABILITY AND GULLY CONTROL

Science and Education Administration, Oxford, MS.  
W. C. Little, R. F. Piess, and A. R. Robinson.  
Paper No. 78-2080, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 18 p, 13 ref. ASAE, St. Joseph, Michigan.

Descriptors: \*Channel erosion, Channel improvement, Stability, Gully erosion, Stream erosion, Stabilization, Environmental effects.

There are a multitude of factors relating to problems of unstable channels and active gullies. There are limited methods of control and additional cost effective methods are required. The potential for improved technology is great. The USDA, Science and Education Administration, Federal Research Program is conducting research on stabilization of stream channels and control of gullies. Channel stability and gully problems and solutions are reviewed and present research programs and future research approaches are described. (Skogerboe-Colorado State)  
W79-05068

# FLUVIAL PROCESSES AND FACIES SEQUENCES IN THE SANDY BRAIDED SOUTH SASKATCHEWAN RIVER, CANADA

McMaster Univ., Hamilton (Ontario). Dept. of Geology.  
D. J. Cant, and R. G. Walker.  
Sedimentology, Vol. 25, No. 5, p 623-648, 1978. 15 fig, 30 ref.

Descriptors: \*Channel morphology, \*Alluvial channels, \*Rivers, \*Braiding, \*Canada, Deposition (Sediments), Geomorphology, Meanders, Streambeds, Sand bars, Sand waves, Movement, Aggradation, Facies (Sedimentary), Stratigraphy, Shape, Discharge (Water), Channels, Shoals, On-site investigations, Flood plains, \*South Saskatchewan River (Canada), Sand flats.

The South Saskatchewan River has a long-term average discharge of 275 cu m/sec, with flood peaks in the range of 1500 to 3800 cu m/sec. South of Saskatoon, the four major types of geomorphological elements recognized are channels, slipface-bounded bars, sand flats and vegetated islands, and floodplains. Major channels are 3-5 m deep, up to 200 m wide, and flow around sand flats which are 50-2000 m long, and around vegetated islands up to 1 km long. At areas of flow expansion, long,

## Field 2—WATER CYCLE

### Group 2J—Erosion and Sedimentation

straight-crested, cross-channel bars form. During falling stage, a small part of the crest of the cross-channel bar may become emergent and act as a nucleus for downstream and lateral growth of a new sand flat. The dominant channel bedforms are dunes, which deposit trough cross bedding. Cross-channel bars deposit large sets of planar tabular cross bedding. Sand flats that grow from a nucleus on a cross-channel bar are composed mostly of smaller planar tabular sets, with some parallel lamination, trough cross-bedding, and ripple cross-lamination. A typical facies sequence related to sand flat growth consists of in-channel trough cross-bedding, overlain by a large (1-2 m) planar tabular set (cross-channel bar), overlain in turn by a complex association mostly of small planar tabular cross-beds, trough cross-beds and ripple cross-lamination. By contrast, a second stratigraphic sequence can be proposed, related only to channel aggradation. It would consist dominantly of trough cross-beds, decreasing in scale upward, and possibly interrupted by isolated sets of planar tabular cross-bedding if a cross-channel bar formed, but failed to grow into a sand flat. During final filling of the channel, ripple cross-lamination and thin clay layers may be deposited. In the S. Saskatchewan, these sequences are a minimum of 5 m thick, and are overlain by 0.5-1 m of silty and muddy vertical accretion deposits. (Humphreys-ISWS) W79-05135

**MATHEMATICAL MODELING OF SEDIMENT DEPOSITION IN RESERVOIRS,**  
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.  
Y. H. Chen, J. L. Lopez, and E. V. Richardson.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 104, No. HY12, Proceedings Paper 14250, p 1605-1616, December 1978. 8 fig, 1 tab, 8 ref.

Descriptors: \*Backwater, \*Model studies, \*Reservoirs, Bed load, Rivers, Mathematical models, Sedimentation, Sediments, Streams, Dams, Deltas, Sediment deposition, Delta formation, River-reservoir system.

When a dam is constructed across a river basin to form a reservoir, the velocity of the flow in the reservoir is reduced and the sediment transported by the river is deposited. These deposits accumulate to form deltas. Estimation of the amount and location of the sediment deposits is required for engineers in the design of dams. A mathematical model was developed for prediction of the delta formation in the reservoir by considering the river-reservoir system as a whole. The river was modeled by a single channel, assuming one-dimensional flow phenomena are predominant; whereas a compound stream model approach was used to simulate the main river and the flood plains in the reservoir. The jet theory was incorporated in the mathematical model, and the resulting flow field was used to route the sediment through the reservoir. The simulated bed profiles generated by the mathematical model compared well with measured data. (Lee-ISWS) W79-05142

**SCOUR AND FILL IN A STREAM CHANNEL, EAST FORK RIVER, WESTERN WYOMING,**  
Geological Survey, Lakewood, CO. Water Resources Div.  
E. D. Andrews.

Available from OFSS, USGS, Box 25425, Fed Ctr., Denver, CO 80225, Paper copy \$11.25, microfiche \$3.50. Geological Survey open-file report 78-928, November 1978. 73 p, 11 fig, 6 tab, 17 ref.

Descriptors: \*Scour, \*Sediment transport, \*Open channel flow, \*Sediment distribution, \*Stream-flow, Flow rates, Low flow, Floods, Channel morphology, Bed load, Sedimentation rates, Discharge(Water), \*Bankfull.

Frequent soundings of 11 cross sections located on the East Fork River, western Wyoming, during a spring flood revealed two sequences of channel scour and fill. All sections either scoured or filled at the flood crests relative to their low-flow condi-

tion. The sections which scoured at high flow (called scouring sections) generally tended to fill at low flow. Conversely, the sections which filled at high flow (called filling sections) generally tended to scour at low flow. The critical discharge at which the character of a section changed from scouring to filling or vice versa was approximately the bankfull discharge. Therefore, at any discharge except bankfull, some sections were accumulating bed material (fill), while others were being depleted of bed material (scour). (Woodard-USGS) W79-05149

**RECONNAISSANCE ASSESSMENT OF EROSION AND SEDIMENTATION IN THE CANADA DE LOS ALAMOS BASIN, LOS ANGELES AND VENTURA COUNTIES, CALIFORNIA,**

Geological Survey, Menlo Park, CA. Water Resources Div.  
J. M. Knott.

Geological Survey open-file report 78-873, 1978. 31 p, 15 fig, 2 tab, 16 ref.

Descriptors: \*Sediment yield, \*Mechanical equipment, \*Accelerated erosion, \*Erosion rates, Evaluation, California, \*Off-road vehicles, Ventura County, Los Angeles County, Hungry Valley, Canada de Los Alamos.

An assessment of present erosion and sedimentation conditions in the Canada de Los Alamos basin, Calif., was made to aid in estimating the impact of off-road-vehicle use on the sediment yield of the basin. Evaluations were made by reconnaissance techniques and by comparing the study area with other off-road-vehicle sites in California. Major-storm sediment yields for the basin were estimated, using empirical equations developed for the Transverse Ranges and measurements of gully erosion in a representative off-road vehicle basin. Normal major-storm yields of 73,200 cubic yards would have to be increased to about 98,000 cubic yards to account for the existing level of accelerated erosion caused by off-road vehicles. Long-term sediment yield of the Canada de Los Alamos basin upstream from its confluence with Gorman Creek, under present conditions of off-road-vehicle use, is approximately 420 cubic yards per square mile per year—a rate that is considerably lower than a previous estimate of 1,270 cubic yards per square mile per year for the total catchment area above Pyramid Lake. (Woodard-USGS) W79-05172

**TRANSPORT MECHANISMS AND HYDRO-CARBON ADSORPTION PROPERTIES OF SUSPENDED MATTER IN LOWER COOK INLET,**

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.

For primary bibliographic entry see Field 5C.  
W79-05218

**MITIGATING ADVERSE ENVIRONMENTAL EFFECTS OF HIGHWAY CONSTRUCTION.**

For primary bibliographic entry see Field 6G.  
W79-05235

**INTERDISCIPLINARY TEAM APPROACH TO MITIGATING ADVERSE ENVIRONMENTAL IMPACTS OF HIGHWAY CONSTRUCTION,**  
Federal Highway Administration, Sacramento, CA. California Div.

For primary bibliographic entry see Field 6G.  
W79-05236

**SILT BARRIERS AS EROSION POLLUTION CONTROL IN A LARGE RECREATIONAL LAKE,**

Federal Highway Administration, Tallahassee, FL. Florida Div.

For primary bibliographic entry see Field 4D.  
W79-05237

**EFFECTIVE DEPTH IN CHANNELS HAVING BED UNDULATIONS,**

Indian Inst. of Tech., Kharagpur. Dept. of Civil Engineering.  
C. R. Pillai.

Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY1, Proceedings Paper 14336, p 67-81, January 1979. 11 fig, 2 tab, 14 ref, 1 append.

Descriptors: \*Beds, \*Channels, \*Depth, Flow resistance, Friction, Hydraulics, Open channel flow, Roughness(Hydraulic), Laboratory tests, Equations, Mathematics, Analysis. \*Bed forms, Friction coefficient(Hydraulics), Skin friction.

Basic experimental studies were conducted in a laboratory flume to investigate the value of the depth of flow as a parameter to be used for computing the friction factor in open channels having bed undulations. The analysis of the experimental data showed that the practice of taking the depth of flow as the mean depth, on the basis of all undulations having been evened in a levelling process, needs modification since the concentration of the undulations plays a significant part. The necessary correction factor for obtaining the effective depth of flow has been suggested. It is believed that the concept of effective depth as developed in this paper would be helpful in future studies on the complex subject of flow in open channels with undulating beds. (Lee-ISWS) W79-05254

**INFLUENCE OF ROW SPACING OF GRAIN SORGHUM ON GROUND COVER, RUNOFF, AND EROSION,**

Science and Education Administration, Temple, TX. Grassland, Soil and Water Research Lab. For primary bibliographic entry see Field 3F.  
W79-05258

**SIZE DISTRIBUTION OF ERODED MATERIAL FROM SIMULATED RAINFALL: EFFECT OVER A RANGE OF TEXTURE,**

Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen.  
D. Gabriels, and W. C. Moldenhauer.  
Soil Science Society of American Journal, Vol. 42, No. 6, p 954-958, November-December 1978. 1 fig, 4 tab, 16 ref.

Descriptors: \*Soil erosion, \*Sediments, \*Particle size, Laboratory tests, Simulated rainfall, Erosion, Soils, Soil types, Sands, Loam, Silts, Clays, Rainfall intensity, Slopes, Soil texture, Soil mechanics, Soil science, Eroded material.

Size distribution of eroded material has implications in deposition mechanics and in carrying capacity for pollutant materials. Dispersed clay stays in suspension virtually as long as water is moving. This dispersed clay, especially the expanding lattice type, has a high carrying capacity for pollutant materials. The aggregated materials high in clay settle according to size and density. The carrying capacity of aggregated materials for pollutants is assumed to be much greater than that of single-grained materials of the same size. Studies of the carrying capacities of the various sizes and compositions of aggregates are in progress. This study reported size distributions and composition of material detached by water drops and transported in shallow flow. The size distributions of aggregates and primary particles in the splashed, washed, and seal material at different times during a laboratory simulated rainfall were compared for different textured soils. The wash had more finer material than did the splash. The wash and splash material at equilibrium were not different from the original soil, while the seal of all soil had a larger silt content than the original soils. The silt loam soil had seals with about the same clay content as the original soil, while silty clay soils had seals with less clay than the original soils. Of significance from this study is the low percentage of dispersed clay being eroded compared to the percent of clay in the original soil and this percentage didn't change significantly with time. The most striking differences were between soils. These differences



were influenced mainly by texture and aggregate condition of the original soils. (Sims-ISWS)  
W79-05259

## NEAR-BOTTOM SEDIMENT CONCENTRATION AND FLUID VELOCITY MEASUREMENTS ON THE INNER CONTINENTAL SHELF, NEW YORK

National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.

For primary bibliographic entry see Field 2L.  
W79-05268

## 2K. Chemical Processes

### AN EXAMPLE OF THE USE OF FACTOR ANALYSIS AND CLUSTER ANALYSIS IN GROUNDWATER CHEMISTRY INTERPRETATION

Birmingham Univ. (England). Dept. of Geological Sciences.

For primary bibliographic entry see Field 2F.  
W79-05143

### GEOHYDROLOGIC DATA FROM TWENTY-FOUR TEST HOLES DRILLED IN THE PICEANCE BASIN, RIO BLANCO COUNTY, COLORADO, 1975-76

Geological Survey, Lakewood, CO. Water Resources Div.

For primary bibliographic entry see Field 2F.  
W79-05164

### DYNAMIC CHANGES IN PH AND COMPOSITION OF ABSORBED CATIONS IN IRRIGATED CHERNOZEMS OF THE TRANS-VOLGA AREA (IN RUSSIAN)

Kuybyshevskii Selskokhozyaistvennyi Inst., Kinel (USSR).

M. M. Razumova.  
Pochvovedenie (7) p 81-88, 1977. English summary.

Descriptors: \*Alkalinity, Sodium, \*Irrigation effects, \*Chernozems.

Under dry Transvolga (USSR) climate the long lasting irrigation of chernozems with water of a bicarbonate type and a periodic appearance of NaCO<sub>3</sub> increased the alkalinity of irrigated soils. The increased alkalinity disturbed the usual composition of cations in soil adsorbing complex of chernozems and changed the adsorbing properties and the energy of adsorption of the main cations: Ca, Mg and Na. Copyright 1978, Biological Abstracts, Inc.  
W79-05226

### CALCITE AS A SOURCE OF EXCESS CALCIUM IN RAINWATER

Tokyo Inst. of Tech. (Japan). Dept. of Environmental Chemistry.

M. Ichikuni.  
Journal of Geophysical Research, Vol. 83, No. C12, p. 6249-6252, December 20, 1978. 1 fig, 2 tab, 18 ref.

Descriptors: \*Chemistry of precipitation, \*Precipitation (Atmospheric), \*Rainfall, \*Snowfall, Chemicals, Chemical analysis, Sodium, Potassium, Magnesium, Calcium, Strontium, Calcite, Foreign countries, Foreign research, Calcium compounds, Dusts, Seawater, Sampling, Meteorology, \*Japan, \*Sendai (Japan), \*China.

Snow and rain samples collected in Sendai, Japan, were analyzed for sodium, potassium, magnesium, calcium, and strontium. The chemical composition of the samples can be explained by adding some calcium to diluted seawater. A low Sr/Ca ratio in most of the samples showed that the excess calcium over seawater contribution may be derived from calcite contained in soil dust transported by wind from North China. (Sims-ISWS)  
W79-05262

### CHLORINE DEGRADATION AND HALOCARBON PRODUCTION IN ESTUARINE WATERS

Maryland Univ., College Park. Dept. of Chemistry.

For primary bibliographic entry see Field 5A.

W79-05451

### INVESTIGATION OF HALOGENATED COMPONENTS FORMED FROM CHLORINATION OF MARINE WATER

Batelle Pacific Northwest Lab., Richland, WA.

For primary bibliographic entry see Field 5A.

W79-05452

### THE EFFECT OF AMMONIA CONCENTRATION ON THE CHEMISTRY OF CHLORINATED SEA WATER

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.

For primary bibliographic entry see Field 5A.

W79-05453

### MICROBIAL DEGRADATION OF HALOGENATED HYDROCARBONS

Texas Univ. at Austin. Dept. of Microbiology.

For primary bibliographic entry see Field 5A.

W79-05454

## 2L. Estuaries

### DIATOM COMMUNITY STRUCTURE: TAXONOMIC AND STATISTICAL ANALYSES OF A MISSISSIPPI SALT MARSH

Mississippi State Univ., Mississippi State. Dept. of Botany.

For primary bibliographic entry see Field 5C.

W79-05007

### MOBILE BAY HYDROGRAPHY UNDER FLOOD STAGE CONDITIONS

Alabama Univ., University. Dept. of Chemical and Metallurgical Engineering.

G. C. April, S. Hu, S. Ng, and C. E. Brett.

In: Coastal Zone 78, Symposium on Technical, Environmental, Socio-Economic and Regulatory Aspects of Coastal Zone Planning and Management, March 14-16, 1978, San Francisco, California. p 1783-1802, 10 fig, 3 tab, 8 ref. OWRT A-061-ALA(1).

Descriptors: \*Discharge, \*Mathematical modeling, \*Flood stages, Flood discharge, Mobile River Basin.

The impact of flood stage river discharges from waters in the Mobile River Basin on water movement and level in Mobile Bay is assessed using mathematical modeling methods. Water elevations and variations in the salinity content of the bay waters are reported for flood conditions occurring between March and May of 1973. This period was selected for purposes of comparing the model results with available field data collected during that period. Comparisons with normal discharge conditions are also made in the study. Wind direction and speed are included in the analysis.  
W79-05008

### COMPUTATION OF SHALLOW WATER WAVES WITH HYBRID FINITE ELEMENTS

Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.

B. Herring.

Advances in Water Resources, Vol. 1, No. 6, p 313-320, December 1978. 16 fig, 16 ref.

Descriptors: \*Waves (Water), \*Water circulation, \*Shallow water, \*Model studies, Mathematical models, Hydraulic models, Finite element analysis, Water levels, Depth, Turbulence, Eddies, Velocity, Circulation, Fluid mechanics, Estuaries.

The numerical computation of two-dimensional, incompressible, long-period, shallow water waves using the method of finite elements was presented.

It was shown that the set of equations solved in each time step is reduced to 1/3 the usual size by satisfying the equations of motion on the element level only (hybrid finite elements). The water levels in all nodes are the sole parameters computed from the set of equations. The velocities were calculated subsequently on the element level in each time step. Special emphasis was placed on reproducing eddies behind corners using an anisotropic turbulent exchange tensor. (Sims-ISWS)  
W79-05022

### HYDROGEOLOGY OF BERMUDA—SIGNIFICANCE OF AN ACROSS-THE-ISLAND VARIATION IN PERMEABILITY

Washington State Univ., Pullman. Dept. of Geology.

H. L. Vacher.

Journal of Hydrology, Vol. 39, No. 3/4, p 207-226, December 1978. 6 fig, 30 ref.

Descriptors: \*Hydrogeology, \*Islands, \*Groundwater movement, \*Permeability, \*Mathematical models, \*Tidal effects, Saline water-freshwater interfaces, Dupuit-Forchheimer theory, Water level fluctuations, Sea level, Shores, Limestones, Zone of saturation, Sea water, Water table, Submergence, Geochemistry, Model studies, \*Bermuda, \*Ghyben-Herzberg lens, Infinite strip model, Transition zone, Asymmetry, Amplitude.

The distribution of fresh groundwater in Bermuda reflects the lateral partitioning of the saturated zone into two sectors: a band of low-permeability limestones (Paget Formation) along one shoreline, and a band of older, more highly permeable limestones (Belmont Formation) along the opposite shoreline. The fresh groundwater occurs preferentially closer to the shoreline composed of Paget Formation. The an-axisymmetric distribution of fresh groundwater results from the effects of the across-the-island variation of permeability on the interface-bounded lens (the theoretical Ghyben-Herzberg lens) and the transition zone, which, in Bermuda, makes up a sizable fraction of the interface-bounded lens. The variation in size of the interface-bounded lens can be modeled closely by application of Ghyben-Herzberg-Dupuit methodologies to an infinite-strip vertically stratified island. The occurrence of fresh groundwater in Bermuda reflects the depositional and diagenetic history of the Pleistocene marginal-marine limestones that compose Bermuda. As a result of these processes operating during a period of large-scale sea level fluctuations, older (intra-Belmont) intercolanite depressions have evolved through a marsh stage and are now interior sounds. The results is the across-the-island variation in permeability. (Visocky-ISWS)  
W79-05031

### NUMERICAL MODEL OF THE CIRCULATION IN AN OPEN BAY

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and the Environment.

B. Petrie, and K. Drinkwater.  
Journal of the Fisheries Research Board of Canada, Vol. 35, No. 12, p 1631-1635, December 1978. 5 fig, 11 ref, 1 append.

Descriptors: \*Water circulation, \*Bays, \*Currents (Water), \*Canada, \*Mathematical models, Coasts, On-site investigations, Model studies, Numerical analysis, Analytical techniques, Analysis, \*Nova Scotia, \*St. George Bay (Nova Scotia), Gyre.

This note briefly reviewed the experimental results that indicate the presence of a mean clockwise circulation in St. Georges Bay, proposed a possible mechanism for driving the gyre, and presented the results of a numerical study of a model open bay. St. Georges Bay, Nova Scotia, is approximately 30 x 30 km, has a mean depth of about 30 m, and is open at its northern end to the Northumberland Strait and the Gulf of St. Lawrence. In 1974 and 1975, a program of current meter moorings and hydrographic measurements was conducted as part of a study of the fisheries and physical oceanography of the bay. An external alongshore current

## Field 2—WATER CYCLE

### Group 2L—Estuaries

setting to the east and across the mouth is proposed as the driving mechanism for the measured clockwise circulation in St. Georges Bay, Nova Scotia. A barotropic numerical model of an open bay forced by an alongshore current was able to produce a clockwise gyre in the bay. The model current velocities were in good agreement with the data. The generation, size, and intensity of the gyre required low values of vertical viscosity relative to horizontal viscosity. (See also W78-12163) (Humphreys-ISWS)  
W79-05134

**CONCEPTUAL REVIEW AND PRELIMINARY DESIGN OF MULTIFARIOUS WATER INTAKE STRUCTURES.**  
Polytechnic Inst. of New York, Brooklyn. Dept. of Civil and Environmental Engineering.  
For primary bibliographic entry see Field 8A.  
W79-05248

**DATA FILE: NEW BEDFORD HARBOR, MASSACHUSETTS.**  
Woods Hole Oceanographic Institution, MA.  
J. P. Ellis, B. C. Kelley, P. Stoffers, M. G. Fitzgerald, and C. P. Summerhayes.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-278 199.  
Price codes: A05 in paper copy, A01 in microfiche. Report No. WHOI-77-73, December 1977. 85 p, 4 fig, 16 tab, 9 ref. NOAA 04-6-158-44016, 04-6-158-44106.

**Descriptors:** \*Massachusetts, \*Harbors, \*Data collections, Oceanography, Water quality, Sediments, Biology, Aquatic life, Biomass, Chemistry, Bottom sampling, Suspended solids, Analysis, Size, Particle size, Estuaries, Wastes, Dispersion, Heavy metals, Carbon, Nitrogen, On-site data collections, On-site investigations, \*New Bedford Harbor(MA), Accumulation, Fine-grained sediments, Sea grant program.

The purpose of this data file was to make available most of the basic data that was collected as part of Woods Hole Oceanographic Institution's study of New Bedford Harbor. The New Bedford Harbor project was designed to examine the past and present patterns of dispersal and accumulation of fine-grained sediments and waste materials in New Bedford Harbor and its approaches. The report was divided into five sections, each dealing with one of the major aspects of the study. The sections are: water quality data, suspended matter, bottom sample locations and size analysis data, chemical data, and biological data. (Froehlich-ISWS)  
W79-05249

**ACOUSTIC MONITORING OF INDUSTRIAL CHEMICAL WASTE RELEASE AT DEEP WATER DUMP SITE 106.**  
Woods Hole Oceanographic Institution, MA.  
Dept. of Ocean Engineering.  
For primary bibliographic entry see Field 5B.  
W79-05264

**THE ANATOMY OF THE ANTARCTIC POLAR FRONT IN THE DRAKE PASSAGE.**  
Woods Hole Oceanographic Institution, MA.  
T. M. Joyce, W. Zenk, and J. M. Toole.  
Journal of Geophysical Research, Vol. 83, No. C12, p 6093-6113, December 20, 1978. 21 fig, 2 tab, 27 ref, 1 append. NSF OCE75-14-56, OCE77-82036.

**Descriptors:** \*Water temperature, \*Salinity, \*Density, \*Antarctic, \*Antarctic Ocean, On-site investigations, On-site data collections, Dissolved oxygen, Waves(Water), Mixing, Heat flow, Heat transfer, Mathematical models, Spatial distribution, Chemicals, Water chemistry, Cold regions, Oceanography, \*Drake Passage, \*Antarctic Polar Fronts, Fronts(Water).

An intensive, three-dimensional survey of the Antarctic Polar Front was made in the Drake Passage in March 1976. The front, which was imbedded within one of the high-velocity cores of the circumpolar current, was viewed as a water mass

boundary demarking the northern extent of near-surface antarctic waters. Within the front, water masses were observed to intrude, one above the other, with characteristic vertical scales of 50-100 m. The intrusions were horizontally anisotropic, being elongated in the along-stream direction and constrained primarily to the upper 800 m of the front. The spatial and temporal persistence of the variability was examined through the analysis of continuous vertical profiles of horizontal velocity, temperature, salinity, and oxygen with discrete sampling of nutrients. Analysis of the velocity data showed the mean current flowing to the NNE with speeds of the order of 30-40 cm/s in the upper 600 m, with total variability over a 28-hour 'yo-yo' due primarily to internal gravity waves. The thermohaline variability was not internal-wave induced, but rather it was associated with nearly isentropic advection of different water masses across the front. Cold fresh and warm salty intrusions did not conserve potential density, however, and double-diffusive transfers are strongly suggested as being crucial to an understanding of the dynamics of the intrusions. Applying a model for lateral mixing, poleward temperature and salinity fluxes due to interleaving of 0.086 C/cm/s and 0.069 parts per thousand cm/s, respectively, were estimated. If these values are typical, interleaving could play a significant role in large-scale balance of salt and, to a lesser extent, heat for the Southern Ocean. (Sims-ISWS)  
W79-05265

**WIND-INDUCED CURRENT FLOW IN THE UPPER HUDSON SHELF VALLEY.**  
National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.  
T. A. Nelson, P. E. Gadd, and T. L. Clarke.  
Journal of Geophysical Research, Vol. 83, No. C12, p 6073-6082, December 20, 1978. 12 fig, 2 tab, 27 ref.

**Descriptors:** \*Winds, \*Currents(Water), \*Continental shelf, \*Atlantic Ocean, \*Model studies, Mathematical models, Current meters, Flow, Turbidity, Suspended solids, Remote sensing, Water circulation, Ocean circulation, Channels, Coasts, Estuaries, \*Hudson Shelf Valley, \*New York Bight.

Drawing from wind and current meter data, an empirical, semiquantitative model was developed for wind-induced current flow in the New York Bight apex portion of the Hudson Shelf Valley. Data showed that winds from 270 deg T (+ or -50 deg), blowing for at least 9 hours at speeds of greater than 5 m/s, can cause northward (upchannel) bottom flow in the shelf valley at velocities in excess of 40 cm/s. Southern (downchannel) flow was initiated by winds from 75 deg T (+ or -35 deg) blowing for at least 6 hours at speeds of 4 m/s or more. Seasonal variation in the wind field resulted in predominant upchannel flow during October-April with downchannel flow throughout the rest of the year. (Sims-ISWS)  
W79-05266

**WAVE-CURRENT INTERACTION MODELS FOR RIP CURRENTS.**  
Delaware Univ., Newark. Dept. of Civil Engineering; and Delaware Univ., Newark. Coll. of Marine Studies.  
R. A. Dalrymple, and C. J. Lozano.  
Journal of Geophysical Research, Vol. 83, No. C12, p 6063-6071, December 20, 1978. 5 fig, 2 tab, 30 ref, 1 append.

**Descriptors:** \*Rip currents, \*Waves(Water), \*Shores, \*Model studies, Mathematics, Foreign research, On-site data collections, Beaches, Foreign countries, Coasts, Ocean waves, Mathematical models, Currents(Water), Equations, \*Isle of Sylt(West Germany), Wave-current interactions.

Two analytic models were developed to describe rip current cells on an open coastline with sloping planar foreshore and flat offshore bathymetry. Both models extended the work of LeBlond and Tang to include the refraction of the normally

incident wave field by the nearshore circulation. The first model included the effect of the currents on the incident wavelength, but no change in wave direction, and showed that no rip currents are possible. The second, more complete model considered the refraction of the waves as well and predicted rip current cells. The spacing of the rip currents and their associated variables were shown to be a function of one dimensionless parameter. Comparison of the predicted spacing with some published field data as well as with measurements obtained on the Isle of Sylt, West Germany, showed reasonable agreement with the second model. (Sims-ISWS)  
W79-05267

**NEAR-BOTTOM SEDIMENT CONCENTRATION AND FLUID VELOCITY MEASUREMENTS ON THE INNER CONTINENTAL SHELF, NEW YORK.**  
National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.  
J. W. Lavelle, R. A. Young, D. J. P. Swift, and T. L. Clarke.

Journal of Geophysical Research, Vol. 83, No. C12, p 6052-6062, December 20, 1978. 15 fig, 19 ref.

**Descriptors:** \*Sediments, \*Currents(Water), \*Continental shelf, \*New York, \*Atlantic Ocean, Turbidity, Suspended solids, Instrumentation, Current meters, On-site investigations, On-site data collections, Ocean currents, Ocean circulation, Water circulation, Velocity, Winds, Tides, Tidal effects, Oceanography.

Prototype instrumentation designed to measure light scattering and transmission and the horizontal components of fluid velocity at a point 100 cm off the sea floor 1976. Depth at the point of deployment was 10.5 m. Data were taken from sensors in hourly bursts consisting of 468 consecutive 1-s samples. Measurements taken with the electromagnetic current sensor were converted to absolute units by using a laboratory calibration, while absolute calibration of the turbidimeter in terms of suspended matter concentration was accomplished by using a combination of laboratory and field measurements. The results from the deployment showed the effects of water motions at both wave and subtidal frequencies on sediment concentrations. Although burst mean fluid motions during the observation interval were primarily of tidal frequency, a single wind-forced event caused burst mean currents in excess of 38 cm/s. During that same event, suspended particulate concentrations rose to a burst mean of 79 mg/l from a prestorm level of 5 mg/l, an order of magnitude increase occurring over a period of approximately 12 hours. During the storm event, individual burst records showed that fluid motions at surface wave frequencies and with amplitudes of over 100 cm/s occurred at the experimental site. The near-bottom suspended matter field at that time was found to have appreciable energy at surface wave frequencies as well. Changes in suspended matter concentration of the order of 130 mg/l were observed to occur in a period of 3-5 s. Increased burst mean concentration was seen to accompany increased wave activity, although increased mean flow with declining wave activity also led to increased suspended particulate concentration. (Sims-ISWS)  
W79-05268

**ALGAE OF SALTMARSHES ON THE SOUTH AND SOUTHWEST COASTS OF ENGLAND.**  
Katholieke Univ., Nijmegen (Netherlands). Lab. voor Aquatische Oecologie.  
For primary bibliographic entry see Field 5C.  
W79-05335

**MEASUREMENT AND SIGNIFICANCE OF SPECIFIC ACTIVITY IN THE HETEROTROPHIC BACTERIA OF NATURAL WATERS.**  
Gordon Coll., Wenham, MA. Dept. of Biology.  
For primary bibliographic entry see Field 5A.  
W79-05490



## Saline Water Conversion—Group 3A

3. WATER SUPPLY  
AUGMENTATION  
AND CONSERVATION

## 3A. Saline Water Conversion

DEVELOPMENT OF DRY-RO MEMBRANES  
FROM SULFONATED CELLULOSE ACETATES  
AND QUATERNIZED CELLULOSE ACETATE CARBAMATESChemical Systems Inc., Tustin, CA.  
R. E. Kesting.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 144. Price codes: A03 in paper copy, A01 in microfiche. Final Report (1978), 40 p, 9 fig, 19 tab, 34 ref. OWRT 7520(1), 14-34-0001-7520.

Descriptors: \*Membranes, Filtration, \*Reverse osmosis, Sulfonates, Cellulose triesters.

The program treated two aspects of ionogenic cellulose reverse osmosis membranes: (1) The feasibility of incorporating anionic (sulfonate groups) charges into cellulose acetate (CA); and (2) the feasibility of the covalent attachment of quaternary ammonium groups via carbamate rather than ester linkages. The synthesis of anionic cellulose triesters (ACTEs), i.e. sulfonated CAs reacted the free OH groups of CA with o-sulfobenzoic anhydride. Precipitation of this polymer into aqueous sodium bicarbonate produced the sodium salt. The addition of the anhydride to CA was found to be nearly quantitative. Permeability increased with increasing ion exchange capacity (I.E.C.). The synthesis of aliphatic sulfonates was effected via sodium bisulfite addition to CA mixed esters containing terminal olefinic groups, e.g. CA undecylenate. Membranes of the sodium salt of CA 11-sulfoundecanoate were the best developed on the ACTE program. ACTE development may be the preferred path for future cellulose RO membrane development. The second part of the program resulted in the simplified approach of in situ formation of CA carbamates. This revolutionary approach consisted of preparing blocked isocyanate monomers bearing quaternary ammonium groups and the inclusion of these monomers in ordinary CA casting solutions such that they wound up incorporated within the final membrane.

W79-05045

## BRACKISH WATER CONVERSION DEMONSTRATION PLANT NO. 4, ROSEWELL, NEW MEXICO; THIRD ANNUAL REPORT

American Hydrotherm Corp., NY.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-185 738. Price codes: A08 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 254, March 1967. 151 p, 25 fig, 10 tab, 9 ref, 3 append. 14-01-0001-322.

Descriptors: \*Desalination plants, \*Demonstration Plant No. 4, \*Forced circulation vapor compression distillation, Capital costs, Operating costs, Operation and maintenance, Evaporators, Desalination apparatus, Distillation, Scaling, Corrosion, Corrosion control, Ion exchange, Brackish water, Equipment, Valves, Tubes, Pipes, Roswell (New Mexico).

The Brackish Water Conversion Demonstration Plant No. 4 at Roswell, New Mexico, a forced circulation vapor compression distillation plant, was operated entirely for the purposes of development during 1966. The work was carried out (1) to eliminate scale formation in the evaporators, (2) to improve equipment performance and reliability, and (3) to resolve corrosion problems. Calcium sulfate, the major scale constituent, was eliminated through modifying the ion exchange equipment and changing the process concentration factor. Metal corrosion from contact with brackish water causes leaks which require frequent shutdowns for repairs. Corrosion products cause tube plugging, influence scale formation in the evaporators, and affect the mechanical performance of the vapor

compressor and valves. Improvements to eliminate these problems included the installation of (1) a cathodic protection system in the second evaporator, and (2) new material for evaluation in the feed pipes and heat exchange tubes. Significant modifications were made on the ion-exchange, vapor compressor, and evaporators to improve performance and reduce maintenance requirements. Demonstration plant capital and operating costs, and theoretical capital and operating costs for a normal-sized plant are presented in addition to monthly production and cost figures. A general discussion of vapor compression distillation includes information on energy costs; energy requirements; pressure level and temperature span for compression; and energy requirement and cost using multiple effects. (Davison-IPA)

W79-05070

## ACID MINE WATER REVERSE OSMOSIS TEST AT KITTANNING, PENNSYLVANIA

General Dynamics Co., San Diego, CA.

A. Riedinger, and J. Schultz.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-184 073. Price codes: A04 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 217, October 1966. 72 p, 25 fig, 18 tab, 1 ref, 2 append. 14-01-0001-752.

Descriptors: \*Desalination apparatus, \*Acid mine water, \*Reverse osmosis, Membranes, Membrane processes, Dissolved solids, Desalination processes, Coal mine wastes, Liquid wastes, Water pollution sources, Water treatment, Water quality, Water quality control, On-site tests, Equipment, Sulfur compounds, Calcium sulfate, Reverse Osmosis Test Unit Pogo I, Kittanning (Pennsylvania).

A field test of the Reverse Osmosis Test Unit Pogo I, operating with two acid mine drainage water feeds in Pennsylvania, was performed to examine the effectiveness of reverse osmosis in concentrating and reclaiming acid drainage from coal mines, and to obtain information to be used in planning future test programs. Various modes of operation and spiral-wound module types were used in tests conducted on a 24-hour/day basis for 10 days. The mine waters tested contained about 2000 ppm total dissolved solids, which were principally calcium sulfate, magnesium sulfate, and ferrous sulfate. Approximately 1100 gallons/day of high quality product water were produced. Operation was maintained over periods of several days with recovery rates at over 90%, although the solubility limits for some constituents were exceeded. The waste brine produced was smaller in volume than the original input feed, and its acid content was highly concentrated. It is concluded that in a highly acidic calcium sulfate, magnesium sulfate water can most likely be concentrated beyond saturation; precautions to avoid aeration of the water may be required when the water contains 100 ppm or more of ferrous iron; and sufficient data was collected to permit the design of a pilot plant to treat acid water inn which Type A membranes would be more desirable than Type C. (Davison-IPA)

W79-05071

## THE OAK RIDGE NATIONAL LABORATORY CONCEPTUAL DESIGN OF A 250-MGD DESALINATION PLANT

Oak Ridge National Lab., TN.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-189 436. Price codes: A18 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 214, September 1966. 300 p, 104 fig, 42 tab, 88 ref, 9 append. 14-01-0001-534.

Descriptors: \*Desalination plants, \*Multistage flash distillation, \*Design criteria, Evaporators, Desalination, Sea water, Electrical equipment, Instrumentation, Heat transfer, Facilities, Operation and maintenance, Costs, Capital costs, Cost analysis, Intake structures, Pumps, Pipes, Valves, Technology.

An in-depth study of the economic and engineering factors affecting the cost and performance of a

250 mgd multistage flash process sea water evaporator is reported. The technology reported is based on plant start up about 1975, and the reference evaporator is presumed to be coupled to a heavy-water-moderated organic-cooled reactor having a heat output of 3300 Mw and a gross electrical output of 675 Mw. The plant, designed for 30 years of service, provides a performance ratio of 1016 of water/1000 Btu, a maximum brine temperature of 250F, and a primary heat exchanger surface of 70% copper and 30% nickel alloy tubing. Computer-based parametric studies were made relating to steam temperature, steam cost, performance ratio, and plant size to the cost of water. Water costs are based on cost equations in which the cost of steam and power vary with water plant capacity and performance ratio. Plant descriptions include single effect and multieffect, multistage designs. The following plant system and components are described: sea water intake system, chemical control systems, dewatering system, brine heaters, evaporator assembly, heat transfer, evaporator structure, demisters, pumps and drives, piping and valves, materials selection, instrumentation and controls, electrical system, plant facilities, operation and maintenance procedures, and site and design criteria. The appendixes contain reference plant drawings. (Davison-IPA)

W79-05072

## ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS WATER PURIFICATION SYSTEM

Kansas Engineering Experiment Station, Manhattan.

L. T. Fan.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-183 991. Price codes: A02 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 332, January 1968. 22 p, 11 fig, 23 ref.

Descriptors: \*Desalination processes, \*Reverse osmosis, \*Systems analysis, \*Optimization, Economics, Mathematical studies, Costs, Economic feasibility, Boundary layers, Reynolds Number, Capital costs, Operating costs, Design data.

A summary of the utilization of systems analysis procedures to model and optimize an entire reverse osmosis system is presented. Water production rate is related to operating pressure, Reynolds Number, and membrane area through the use of a boundary layer flow model. Cost equations relating capital and operating costs to the design variables are developed, and used in economic optimization studies of several reverse osmosis studies. The optimal conditions for three stage systems were determined using the discrete version of the maximum principle along with search procedures. The optimal pressure, Reynolds Number, and ratio of membrane to feed flow rate were determined. The optimal results for three cases are tabulated: (1) a three stage process with a turbine for depressurization; (2) a three stage process with a flow work exchanger; and (3) a three stage system with an equal membrane area to feed flow ratio in each stage. The results show minimum costs for the three stage system with the depressurization turbine to be \$44/1000 gallons, \$37/1000 gallons for the three stage system with a flow work exchanger, while comparable costs for a one stage system with a turbine for depressurization are \$49/1000 gallons, and \$39/1000 gallons for an on stage system with a flow work exchanger. It is concluded that modern optimization procedure, i.e., discrete version of the maximum principle combined with search techniques, can be used in optimizing reverse osmosis desalination systems. Details of this study, including the derivation of the formulae, are contained in: 'Analysis and Optimization of a Reverse Osmosis Water Purification System; Special Report No. 73'. (Davison-IPA)

W79-05073

## COST ANALYSIS OF SIX WATER DESALTING PROCESSES

Stanford Research Inst., Menlo Park, CA.

C. F. Clark.

Available from the National Technical Information

## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3A—Saline Water Conversion

Service, Springfield, VA 22161 as PB-200 908. Price codes: A06 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 495, November 1969. 108 p, 25 fig, 25 tab, 58 ref. 14-01-0001-2236.

Descriptors: \*Desalination processes, \*Capital costs, \*Multistage flash distillation, Vertical tube evaporator, Vapor compression distillation, Vacuum-freeze vapor compression, Reverse osmosis, Electrodialysis, Amortization, Equipment, Indirect costs, Design data, Brackish water, Saline water, Water treatment, Water purification, Desalination plants.

The capital cost requirements and cost of producing fresh water were determined for the following six desalination processes which are currently considered most economically favorable for application within the U.S.: (1) multistage flash distillation (MSF); (2) vertical tube evaporator (VTE) combined with MSF; (3) vapor compression distillation (VC) combined with VTE and MSF; (4) vacuum-freeze vapor compression (VFVC); (5) reverse osmosis (RO); and electrodialysis (ED). The ground rules for the study, established by the Office of Saline Water, include plant capacity, equipment amortization, indirect capital costs, recurring costs, supplies and maintenance materials, energy unit costs, and chemical costs. The land costs used in preparing the estimates were \$100,000/acre for sea coast locations, and \$25,000/acre for inland brackish water plants. The cost of feed water intake and brine disposal lines were not included for sea water conversion plants, and no provision was made for the cost of collecting feed water or disposal of the brine concentrate for plants using brackish feed water. The major cost elements for each process are identified, and the effects of varying process parameters on water costs are shown for each. Plant designs for each process are presented, and the future development of each is discussed. The results of the unit costs of the important process variables are presented in graphical form. (Davison-IPA)

W79-05074

#### A STUDY OF DESALTING PLANTS (15 TO 150 MGD) AND NUCLEAR POWER PLANTS (200 TO 1500 MWt) FOR COMBINED WATER AND POWER PRODUCTION.

Catalytic Construction Co., Philadelphia, PA. Available from the National Technical Information Service, Springfield, VA 22161 as PB-166 396. Price codes: A17 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 124, November 1964. 325 p, 35 fig, 76 tab, 21 ref, 8 append. 14-01-0001-367 and AT (30-1) 3316.

Descriptors: \*Desalination plants, \*Electric powerplants, \*Nuclear reactors, \*Multistage flash evaporation, \*Steam turbines, \*Fossil fuels, Natural gas, Costs, Capital costs, Water rates, Electric power costs, Economics, Cost comparisons, Electric power production.

The results of an economic analysis of combination plants which produce electric power and potable water from sea water are presented. In these plants, high pressure steam is fed to a turbo-generator to produce electric power; low pressure steam is exhausted from the turbine and condensed in the brine heaters of a multistage flash evaporation water desalination plants. Two types of steam supply systems, nuclear reactors and conventional, natural gas-fired boilers, were studied. The nuclear reactors are in two classes: a low temperature type which produces saturated steam at 300 to 600F, and a high temperature type which produces steam at 1000F. Two classes of fossil fuel plants were hypothesized, delivering steam at comparable conditions with the nuclear reactors. Intermediate sized plants ranging from 200 to 1500 MWt input were examined, and calculations were conducted at 200, 600, 1000, and 1500 MWt. Calculations were also made to determine the cost of producing water in single purpose water-only plants. Water costs are tabulated for the various dual purpose and water-only plants. Where plant size, energy source, fixed charge rate, and the power credit factor are equal, water is more economically pro-

duced by dual purpose plants. The results indicate that small sized fossil fuel plants with higher fixed charge rates are competitive due to the higher capital cost requirements of nuclear reactors. Low temperature systems are favored where the plant capacity is low with a low power credit factor and a high fixed charge rate. (Davison-IPA)

W79-05075

#### AN ENGINEERING EVALUATION OF THE LONG-TUBE VERTICAL FALLING-FILM DISTILLATION PROCESS.

Dow Chemical U.S.A., Freeport, TX. Texas Div. Available from the National Technical Information Service, Springfield, VA 22161 as PB-177 202. Price codes: A14 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 139, February 1965. 294 p, 35 fig, 37 tab, 54 ref, 3 append. 14-01-0001-397.

Descriptors: \*Desalination plants, \*Demonstration Plant No. 1, \*Evaluation, \*Design, \*Long-tube vertical multiple effect distillation, Falling-film, Equipment, Sampling, Chemical analysis, Design criteria, Evaporators, Desalination apparatus, Desalination processes, Freeport(Texas).

An extensive engineering study was undertaken to evaluate Demonstration Plant No. 1 in Freeport, Texas. The plant is a long-tube, vertical, falling-film, multiple-effect distillation type and has been successfully operated for three years. Heat and material balances for three sets of operating conditions were calculated. The preheaters and cross exchangers were evaluated for the current operation, and designed for two others. Sampling and chemical analysis were included in the study of the deaerator and its operation. The evaporator design was assessed under three sets of conditions for varying tube sizes and brine recirculation rates. The present operation of the entrainment-separator design was evaluated, and the use of wire mist eliminators was studied. Construction materials and corrosion problems of the plant were studied; samples were examined, and radio logs were taken. The pumps, mechanical equipment and plant instrumentation were also evaluated. Nine major conclusions are presented; specific conclusions are contained throughout the report. Among the major conclusions are: the most economical process is the operation of the plant at an Effect 1 temperature of 300F with ion exchange softening of the sea water feed; with the process improvements determined by this evaluation, a normalized 1 mgd plant was designed at a capital cost of \$1,518,570 to operate for \$1.16/1000 gallons; and the first effect temperature should not exceed 240F to prevent anhydrite formation, and to prevent gypsum formation, the last effect concentration factor should not exceed three times normal sea water. (Davison-IPA)

W79-05076

#### RESULTS OF A PRELIMINARY SURVEY OF CANDIDATE COMMUNITIES FOR SALINE WATER DEMINERALIZATION APPLICATIONS.

Black and Veatch, Kansas City, MO. Available from the National Technical Information Service, Springfield, VA 22161 as PB-173 673. Price codes: A17 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 162, March 1966. 396 p, 1 fig, 2 tab. 14-01-0001-320.

Descriptors: \*Desalination, \*Surveys, \*Demineralization, \*Water resources development, \*Cities, \*Water requirements, Water supply, Saline water, Brackish water, Water wells, Available water, Water resources, Water demand, Water utilization, On-site investigations, Sea water, Groundwater, Surface water availability.

In Phase I of a two phase report, 10,000 communities were screened as to the feasibility of saline water conversion on the basis of the following criteria: (1) community growth, (2) no existing supply plant, (3) ample rainfall areas, (4) ample fresh water source, (5) saline source, sea water, and (6) saline source, inland ground and surface sup-

plies. This screening indicated about 2,800 communities where saline conversion might be applicable, and a questionnaire was prepared to establish the adequacy of fresh water sources to supply present and future needs and to determine the availability of saline water sources for potential supplies. The questionnaire information was evaluated and used with data compiled from state and Federal agencies to select 180 communities/water utilities as candidates for saline water demineralization applications. These candidate-communities are summarized in tabular form. In Phase II the existing water situation was evaluated, and the availability of fresh and/or saline water sources in the 180 communities was assessed. On-site investigations of each community were conducted and interviews were made in communities located in water supply problem areas. A field investigation was carried out to ascertain current annual water requirements. Field contacts in addition to interviews with municipal and utility officials of the selected 180 communities are listed. (Davison-IPA)

W79-05077

#### THIRD ANNUAL REPORT: BRACKISH WATER CONVERSION DEMONSTRATION PLANT, WEBSTER, SOUTH DAKOTA.

Mason-Rust, Louisville, KY. Available from the National Technical Information Service, Springfield, VA 22161 as PB-178 310. Price codes: A05 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 164, September 1965. 98 p, 11 fig, 14 tab, 1 append. 14-01-001-225.

Descriptors: \*Desalination plants, \*Evaluation, \*Brackish Water Conversion Demonstration Plant No. 3, \*Electrodialysis, Desalination processes, Scaling, Equipment, Capital costs, Operating costs, Desalination apparatus, Water treatment, Water quality, Water quality control, Pretreatment(Water), Brackish water, Webster(South Dakota).

Plant maintenance, operational history, and technical, economic, and administrative evaluations of the Brackish Water Conversion Demonstration Plant No. 3 in Webster, South Dakota, are reported for July 1, 1964 through June 30, 1965. General membrane scaling, selective scaling of the cathode area, poor process performance with water from well number five, stack resistance instability, and pretreatment deficiencies remain the areas of concern. Equipment failures included the iron/manganese pretreatment system. Capital and operating costs for Demonstration Plant No. 3 are compared with normalized capital and operating costs for electrodialysis plants with capacities of 250,000, 1,000,000 and 2,000,000 gallons/day. Direct and indirect monthly operating costs and the corresponding monthly water production are tabulated. These costs were influenced by the downtime required by equipment modifications, and failures. (Davison-IPA)

W79-05078

#### OPERATION AND MAINTENANCE OF 37,000 GPD THIN-FILM DISTILLATION PILOT PLANT.

General Electric Co., Burlington, VT. Available from the National Technical Information Service, Springfield, VA 22161 as PB-180 060. Price codes: A05 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 181, April 1966. 78 p, 48 fig, 3 tab. 14-01-0001-248.

Descriptors: \*Desalination plants, \*Desalination apparatus, \*Pilot plants, \*Testing, On-site tests, Research and development, Equipment, Evaluation, Evaporators, Heat exchangers, Thin films, Valves, Sea water, Distillation, Wrightsville Beach(North Carolina).

Pilot plant equipment testing and maintenance at the Research and Development Test Station located at Wrightsville Beach, North Carolina, are reported for May 1963 through June 1965. Pilot plant equipment consists of: double-fluted tube evaporator, wiped-film evaporator, deaerator, six



Saline Water Conversion—Group 3A

heat exchangers, seven pumps, two steam reducing valves, level controllers, switchgear, salinity measuring equipment, and pH measuring equipment. The data from single-effect and double-effect test runs are discussed and illustrated by graphic representations. The second-effect evaporator was modified to become a 10-ft long double-fluted tube thin-film evaporator. The conclusions resulting from the test program include: (1) the thin-film process of evaporation distillation is adaptable to intermediate and large size multiple-effect plants for converting seawater to fresh water; (2) the fluted tube design is an advanced method for obtaining thin films and high heat transfer rates through a metal barrier; (3) the five and ten foot double fluted tubes can be advantageously incorporated into the large multiple-effect evaporator design; (4) deaeration of the sea water to low values of oxygen content is feasible with the proper design of the stripping vessel; and (5) scale prevention utilizing pH control at temperatures through 275F is possible over long periods with normal brine concentrations in the thin film process. (Davison-IPA)  
W79-05079

**RESEARCH ON AND ANALYSIS OF SINGLE-EFFECT LOW TEMPERATURE FLASH EVAPORATION PROCESS.**

Baldwin-Lima-Hamilton Corp., Philadelphia, PA. Industrial Equipment Div. Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 393, Price codes: A06 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 18. (1957). 70 p, 24 fig, 12 tab, 7 ref. 14-01-001-90.

Descriptors: \*Desalination plants, \*Design criteria, \*Evaluation, Research and development, Estimated costs, Engineers' estimates, Water rates, Pumps, Laboratory tests, Flash distillation, Desalination processes, Water purification, Industrial wastes, Liquid wastes, Feasibility studies.

Design studies of single stage flash evaporators utilizing the heat in waste streams from power plants, oil refineries, industrial plants, or natural streams were made. Preliminary designs and cost estimates were based on temperature differences of 15 and 30F between the heated water and the available cooling water. The two studies made for each of these temperature differences were for plants with 1,000,000 and 10,000,000 gpd capacity, and included conception of ideas, rough sketches, rating calculations, design and detail drawings for cost estimations, and arrangement drawings. The final drawings are contained in the report. Information on air removal methods and quantities of air to be removed from low pressure flash distillation apparatus was obtained through literature studies, direct contact with equipment vendors, and laboratory tests on dissolved gases. It is concluded that: low temperature flash evaporation of warm saline waters is theoretically sound, technically feasible, and proven by actual installations which have been operating for years; water could be produced by this process for about \$1.20/1000 gallons in a 10,000,000 gpd plant, and about \$1.75/1000 gallons in a 100,000 gpd plant; and none of the pumps selected for removing air from evaporators was ideally suited, and a final selection must be based on an evaluation of the local conditions and economics for individual plants. (Davison-IPA)  
W79-05080

**AN ENGINEERING EVALUATION OF THE ELECTRODIALYSIS PROCESS ADAPTED FOR COMPUTER METHODS FOR WATER DESALINATION PLANTS.**

Mason-Rust, Webster, SD. Available from the National Technical Information Service, Springfield, VA 22161 as PB-177 077, Price codes: A11 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 134, February 1965. 246 p, 37 fig, 13 tab, 52 ref, 2 append. 14-01-0001-437.

Descriptors: \*Desalination plants, \*Evaluation, \*Engineering, \*Electrodialysis, \*Computer programs, Mathematical studies, Economic feasibility, Brackish water, Saline water, Water purification, Feasibility studies, Costs, Water rates, Capital costs.

The electrodialysis process is evaluated; mathematical relationships predicting the costs of the electrodialysis process to convert selected saline waters to potable water are presented; technical problems leading to the design of electrodialysis plants are reviewed; and areas where additional research and development can reduce the cost of water produced by electrodialysis are identified. A computer program, using Fortran II, was designed to operate on any possible combination of the following variables: six capacities, six waters, two climates, two mean current densities, four labor rates, two product water storage times, two interest rates, and four electrical rates. This program is readily adapted to make use of future developments related to the variables. It is concluded that it is technically feasible to desalinate most natural saline waters with the electrodialysis process; economic feasibility has been proven for brackish water in the 1,000 to 10,000 ppm range; the cost of converting brackish water to potable water ranges from 40 cents to \$1.50/1000 gallons, depending on the water analysis and plant capacity; and an economically optimum, practical plant capacity is about 5,000,000 gpd. (Davison-IPA)  
W79-05081

**THIRD ANNUAL REPORT: SALINE WATER CONVERSION DEMONSTRATION PLANT NO. 1, FREEPORT, TEXAS.**

Stearns-Roger Corp., Denver, CO. Available from the National Technical Information Service, Springfield, VA 22161 as PB-193 120, Price codes: A09 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 123, September 1964. 174 p, 39 fig, 28 tab, 11 ref, 1 append. 14-01-001-218.

Descriptors: \*Desalination plants, \*Desalination processes, \*Long-Tube vertical distillation, \*Desalination, Water purification, Mechanical equipment, Hydraulic machinery, Economics, Capital costs, Operating costs, Cost analysis, Cost comparisons, Evaluation, On-site investigations, Corrosion, Construction materials, Evaporation, Construction, Demonstration Plant No 1, Scaling.

Information concerning the Long-Tube Vertical (LTV) multiple-effect evaporation method of desalination employed by Demonstration Plant No. 1, Freeport, Texas, is presented. The technical, logistical, and economic evaluations for fiscal year 1964 operations are discussed in addition to the process and mechanical development program results as related to the LTV process in particular and desalination in general. Capital and operating costs are compared to theoretical normalized capital and operating costs. Production, economy ratios, cost averages, and maintenance problems are presented. A technical evaluation of the existing process, equipment, corrosion, and construction materials is included. The process evaluation includes limitations to the temperatures and concentration ratios for scale-free operation of LTV evaporators without preheating the feed water. Each category of process equipment was evaluated. Information concerning the performance of the subsystems emphasizes the deaerator-decarbicator. Plant heat and material balance is illustrated by a flow diagram. (Davison-IPA)  
W79-05082

**INVESTIGATION AND PREPARATION OF POLYMER FILMS TO IMPROVE THE SEPARATION OF WATER AND SALTS IN SALINE WATER CONVERSION.**

Monsanto Research Corp., Everett, MA. Boston Lab. Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 467, Price codes: A04 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 69, December 1962. 71 p, 16 fig, 20 tab, 6 ref, 2

append. 14-01-001-203.

Descriptors: \*Membranes, \*Polymers, \*Desalination, \*Membrane processes, Permeability, Films, Thin films, Ion exchange, Laboratory tests, Hydrogen bonding, Water purification, Water treatment, Water quality, Water quality control, Surfactants.

An experimental program to investigate and evaluate cellulose acetate films, and to clarify the basic principles of film performance is reported. Polymeric films of currently available materials were prepared and tested. A cellulose acetate composition containing 10% PEG-200 has a transmission rate of 1.07 g/cm<sup>2</sup>/hr with more than 90% salt rejection. An increased rate and improved salt rejections resulted from the development of a thermal method of film treatment. Modified polyvinyl alcohol and cellophane films gave improved salt rejection and maintained good transmission rates. The effects of wetting agents and hydrogen bonding on film performance are discussed. Film processing variables on film structure were determined. (Davison-IPA)  
W79-05083

**UTILIZATION OF ISOTOPES FOR SALINE WATER CONVERSION.**

Chance Vought Corp., Dallas, TX. Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 469, Price codes: A18 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 68, December 1962. 398 p, 131 fig, 14 tab, 60 ref, 8 append. 14-01-001-210.

Descriptors: \*Desalination, \*Radioisotopes, \*Desalination apparatus, Economic feasibility, Compatibility, Design data, Nuclear energy, Nuclear wastes, Costs, Cost estimates, Saline water, Water purification, Water treatment, Equipment, Laboratory tests, Hazards, Evaluation, Technology, Research and development.

A study involving the use of radioisotope power as a heat source for desalination is presented in three sections. A preliminary analysis of the economic feasibility of radioisotopes for desalination, and a parametric analysis of the economic feasibility of nuclear heat sources are presented in Section I. In Section II the various design parameters and associated compatibility problems were studied, and a conceptual design of a nuclear heater capable of supplying the thermal requirements for a 1,000,000 gpd desalination plant operating at 200 kw/1000 gallons was developed. The design of a laboratory test model, based on the data of Section II and capable of producing 250 gpd of fresh water from saline water, is presented in Section III. The conversion system of this model was completely designed and analyzed for hazards. It is concluded that the most economic source of energy for this type of power is the calcined fission product waste from processed spent reactor fuel elements. (Davison-IPA)  
W79-05084

**RESEARCH AND DEVELOPMENT OF PROCESSES FOR DESALTING WATER BY FREEZING.**

Washington Univ., Seattle. Engineering Experiment Station. H. H. Hendrickson, and R. W. Moulton. Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 385, Price codes: A08 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 10, August 1956. 172 p, 53 fig, 36 tab, 13 ref, 5 append. 14-01-001-73.

Descriptors: \*Desalination, \*Desalination processes, \*Freezing, \*Sea water, Ice-brine systems, Ice-water interfaces, Separation techniques, Centrifugation, Economics, Cost analysis, Cost comparisons, Desalination apparatus, Vapor compression distillation.

Field tests were run with sea water on commercial and industrial icemakers of all available types. These icemakers included can-ice plants, flake-ice

## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3A—Saline Water Conversion

machines, slush-ice machines, tube-ice machines and ice cream freezers. Although saline reduction was obtained, no commercial ice-maker reduced the 30,000 ppm total solid content of sea water down to the 500 ppm of potable water. The performance of several representative ice-makers were studied in the laboratory under controlled conditions to determine the best methods to separate entrapped salt from ice-brine mixtures. Theoretical studies were made of freezing cycles to find the most efficient one; economic studies were made of the most promising ones. During the testing it was determined that primary function of the freezing is to produce an ice-brine mixture that is readily separable. Auxiliary separating equipment will be required, because a certain amount of salt brine is always entrapped by the pure ice crystals. The separation methods studied were: centrifugation, gravity draining, vacuum draining, and compression. Compression gave the best results below 2000 ppm. Cost analysis were made comparing freezing to a hypothetical multiple-effect vapor compression distillation plant. Costs were \$2.31/1000 gallons for freezing and \$1.94/1000 gallons for a 12 effect distillation plant. (Davison-IPA) W79-05085

#### TEST MANUAL (TENTATIVE) FOR PERMELECTIVE MEMBRANES.

Bureau of Reclamation, Denver, CO.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 575, Price codes: A10 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 77, January 1964. 208 p, 20 fig, 1 tab. 14-01-001-165.

Descriptors: \*Permelective membranes, \*Cation, \*Anion, \*Testing procedures, Chemical analysis, Chemical properties, Physical properties, Physico-chemical properties, Sampling, Storage, Desalination, Electrodialysis.

A set of specific, standardized test methods covering sampling, storing, and shipping of anionic and cationic permselective membranes is presented. The tests are listed according to the properties to be measured, and they are numbered as follows: 100. methods of inspection and sampling; 200. sample preparation, storage, and shipment; 300. visual test methods; 400. physical test methods; 500. chemical test methods; 600. electromechanical test methods; 1000. reporting results; and 2000. theory and glossary of terms. Individual tests and procedures are indicated by a change in the final digits of the basic category number, and different methods used to determine the same class of properties, or similar methods used to determine the same property with different materials are indicated by digits after the decimal point. Although the tests in this manual are primarily for permselective membranes to be used in the electrodialysis desalination process, it is believed that they can be adapted for other process requirements by changing reagents or other test conditions. (Davison-IPA) W79-05086

#### SOLAR DISTILLATION OF SEA WATER IN THE VIRGIN ISLANDS,

G. O. G. Lof.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 380, Price codes: A03 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 5, February 1955. 41 p, 6 fig, 3 tab, 7 ref, 2 append.

Descriptors: \*Desalination, \*Solar distillation, \*Solar stills, Desalination apparatus, Water purification, Separation techniques, Sea water, Desalination processes, Virgin Islands, Water yield, Water supply, Heated water, Heat balance, Evaporation.

The experimental program using a solar still consisting of a 4 x 9 ft horizontal evaporating pan covered with 45 degree sloping glass panels is discussed. Sea water was supplied to the tray to a depth of 1 to 2 inches, and evaporation took place as the sun warmed the black bottom of the pan.

Distilled water condensed on the inside of the glass panels and ran down into troughs at the base of the panels. The water was collected and measured hourly during the experimental runs from November 26, 1948 to April 4, 1949. The water temperature in the still was measured, the sky condition was noted, and the total water production for each day was computed. Under the average prevailing solar conditions of the Caribbean Islands' winter, the still operated at about 35% solar utilization efficiency with a daily yield of about 0.6 lb of water/sq ft of evaporator pan. This yield, about half of the ideal yield for this type of equipment, would be improved by reducing heat losses. Experiments with preheated water showed a substantial increase in yield. It is concluded that distilled water could be produced in the Virgin Islands for about \$1.00/thousand gallons if this type of distillation equipment could be built for \$1.00/sq ft of pan area and in a government owned plant with a fixed charge of 5%/year. (Davison-IPA) W79-05087

#### DEMINEALIZATION OF SALINE WATER WITH SOLAR ENERGY,

G. O. G. Lof.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 379, Price codes: A05 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 4, August 1954. 84 p, 20 fig, 5 tab, 67 ref. 14-01-001-55.

Descriptors: \*Desalination processes, \*Solar distillation, \*Desalination apparatus, Solar stills, Evaporators, Water treatment, Water purification, Economic feasibility, Costs, Construction costs, Estimated costs, Water rates, Saline water, Deminealization.

Numerous proposed methods for deminealizing saline water with solar energy have been analyzed from the engineering and economic viewpoints, and probable minimum costs for producing fresh water with these methods have been estimated. The two main categories of solar deminealization processes are those using electric energy generated in a solar power plant, and those using heat developed in a solar energy absorber. The major types of solar deminealization are compared with each other and with conventional evaporation methods. Those processes possessing better utilization prospects are further analyzed. Individual investment and operating cost items are tabulated, and approximate total water production costs for a one million gpd plant are determined. The cost of producing water with these methods ranges from \$1.00 to \$4.00/1000 gallons. A large, publicly owned sea water deminealization plant employing glass covered evaporation pans at an investment cost of \$1.00/sq ft of evaporating surface could produce fresh water at approximately \$1.60/1000 gallons. It is concluded that only solar evaporation can be economically competitive with the least expensive conventional methods, and that the simple, direct heated solar still is economically superior to other solar deminealization equipment. (Davison-IPA) W79-05088

#### FURTHER PROPERTIES OF HYDRATES AND HYDRATING AGENTS.

Syracuse Univ., Research Corp., NY.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 425, Price codes: A05 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 70, January 1963. 75 p, 11 fig, 15 tab, 8 ref, append. 14-01-001-177.

Descriptors: \*Hydrates, \*Hydrate processes, \*Solubility, \*Solubility apparatus, \*Crystal growth, Crystallization, Freezing, Deminealization, Desalination, Separation techniques, Supercooling.

Research results on the thermodynamic properties and solubilities in hydrate systems and on the rates of growth of ice crystals are presented. A solubility apparatus was used in experiments to test F-21,

F-31, methyl bromide, F-142b, and F-12B1. Results of those solubility tests are summarized in tabular form. Data on chlorine, propane, methyl chloride and F-12 are included. It is concluded that propane is the least soluble of the hydrating agents and F-31 is the most soluble. Preliminary work in the study of the kinetics of hydrate growth has been on ice crystal growth. A summary of previous ice crystal growth work is presented. (Davison-IPA) W79-05089

#### SOLIDIFICATION AND SEPARATION OF ICE FROM SALINE WATER.

Massachusetts Inst. of Tech., Cambridge.  
C. M. Adams, Jr., and P. K. Rohatgi.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 591, Price codes: A03 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 94, March 1964. 40 p, 22 fig, 4 ref. 14-01-0001-279.

Descriptors: \*Desalination, \*Freezing, \*Ice-water interfaces, \*Crystal growth, \*Boundaries(Surface), \*Ice-brine systems, Magnetic studies, Electric fields, Aqueous solutions, Crystallization, Desalination processes, Separation techniques, Water treatment, Water purification, Ice.

In an investigation of the mechanism of solidification of aqueous solutions, droplets and aqueous solutions on a flat surface were frozen and magnetic and electric fields were externally applied to the frozen samples; microphotography was used to study the dendrite structures and spacings of these samples. It was found that in dilute aqueous solutions generally the crystal line aggregate takes the form of groups of parallel uniformly spaced plates. Plate spacing is dependent on the freezing rate, and varies with concentration and magnetic fields. The individual plates in the dendrite structure are pure ice, and the salt is displaced to regions between the plates. Large areas of brine were observed in irregular masses between neighboring groups of dendrites. Dendrite spacing increases with salt concentration up to the melting-freezing point, and an increase in concentration influences the character of the individual dendritic plates. Stationary magnetic fields increase dendrite spacing for a given freezing rate; an increase in the magnetic field induces serrations and side branching of dendritic plates. It is concluded that under fast freezing conditions, binary and ternary aqueous solutions with a wide range of concentrations produce groups of parallel plate-shaped dendrites, and that magnetic fields are less influential when freezing is initiated from a solid chill surface under gradient freezing conditions than under uniform freezing rates. (Davison-IPA) W79-05337

#### ECONOMIC AND TECHNICAL EVALUATION OF THE WIPED FILM EVAPORATOR,

General Electric Co., Burlington, VT.  
R. E. Anderson, and C. W. Lotz.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 686, Price codes: A03 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 105, July 1964. 37 p, 14 fig, 1 tab. 14-01-0001-248.

Descriptors: \*Desalination, \*Desalination processes, \*Desalination plants, \*Wiped film evaporator, Pilot plants, Testing, Evaluation, Equipment, Economics, Capital costs, Operating costs, Sea water, Evaporation, Heat transfer, Films, Wrightsville Beach(North Carolina).

Tests conducted on the wiped film evaporator at the pilot plant at Wrightsville Beach Test Station in North Carolina are described. The pilot plant is a double effect type plant employing the double flute evaporation process as well as the wiped film evaporator. Data obtained during the shake-down runs of the entire plant indicated needed improvement for the following wiped film still components: lower shaft bearing, upper shaft bearing, gear box bearings, tube wall, acid line, and condenser shell vent. Six single effect wiped film tests



## Saline Water Conversion—Group 3A

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were run during October 1963 after the recommended modifications had been made. Evaporation temperature ranged from 170 to 210F, temperature differences were 5 and 10 degrees F, while the blowdown concentration factor remained constant. Performance was better at the lower temperature difference because the smaller quantity for sea water feed results in a thinner, less resistant evaporating film. Estimated capital costs for a one mmgd wiped film plant are presented and include equipment and construction costs. Estimated annual operating costs include fuel costs, power costs, chemical costs, maintenance, and labor costs. The cost of product water from a wiped film evaporator is \$1.46/1000 gallons. (Davison-IPA) W79-05358

#### THERMODYNAMIC PROPERTIES OF SALINE WATER,

Monsanto Research Corp., Everett, MA. Boston Lab.

W. H. Power, and B. M. Fabuss.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 685. Price codes: A05 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 104, July 1964. 85 p, 22 fig, 8 tab, 24 ref, 1 append. 14-0001-294.

Descriptors: \*Desalination, \*Calcium sulfate, \*Water chemistry, \*Thermodynamics, \*Physicochemical properties, Hydrates, Anhydrite, Calcium compounds, Gypsum, Laboratory tests, Saline water, Water properties, Water analysis, Solubility.

The solubility of calcium sulfate and its hydrates in pure and saline waters from 25 to 250C were determined to obtain experimental information on the thermodynamic properties of certain components present in saline waters. The preparation and characteristics of the calcium sulfate modifications and its hydrates used in this study are listed for gypsum, selenite (natural), alpha-hemihydrate, beta-hemihydrate, beta soluble anhydrite, insoluble anhydrite, and insoluble anhydrite (natural). The three experimental units, low temperature, intermediate temperature, and high temperature, are described. Solutions, solids and specific conductances of calcium sulfate solutions were analyzed, and the summary of these solubility measurements are tabulated. Vapor pressure measurements and density measurements have not been made, but the equipment with which these measurements will be made is described. It is concluded that data obtained in this study are in good agreement with the data in literature. (Davison-IPA) W79-05359

#### HEAT TRANSFER AND CORROSION CHARACTERISTICS OF CAPILLARY FLUTED ALUMINUM TUBES,

AIResearch Mfg. Co. of Arizona, Phoenix.

E. L. Kumm.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-166 241. Price codes: A05 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 103, October 1964. 81 p, 39 fig, 3 tab, 18 ref. 14-01-0001-362.

Descriptors: \*Desalination, \*Desalination processes, \*Vapor compression distillation, \*Desalination apparatus, \*Thin films, \*Aluminum, \*Aluminum alloys, \*Corrosion, Coatings, Cathodic protection, Surfaces, Tubes, Heat transfer, Evaporation, Sea water, Economic justification.

A theoretical and experimental study of techniques to improve thin-film evaporation by using fluted aluminum tubes is presented. A discussion of the vapor compression distillation system for desalination of sea water includes thermodynamic considerations, heat transfer in evaporator condenser tubes, aluminum corrosion, and economic considerations. The many coatings used to improve the resistance of the naturally oxidized surface of aluminum are divided into two classes: (1) chemical conversion treatments including anodizing bath, oxide formation, chromate conversion, and boehmite formation; and (2) film coatings including

plastics and metals. They can be used separately or in combination. Immersion tests were made of aluminum alloy samples with various coatings and sea water. The best coating tested consisted of an aluminum alloy covered with a boehmite film. The overall results show that aluminum is very resistant to sea water corrosion when the water is uncontaminated by the heavy metal ions, copper, iron and nickel. A boehmite-coated tube given cathodic protection showed no surface pitting after being subjected to applied voltage equivalent to about 5 microamperes/sq ft of tube surface for 1080 hours. Microscopic examination of fluted tubes revealed salt deposits had occurred on the sharpest edges and in the crevices, except for the tube internally coated with silicone UCAR 101. (Davison-IPA) W79-05360

#### INVESTIGATION OF THERMAL DIFFUSION FOR SALINE WATER CONVERSION,

Philco, Newport Beach, CA. Research Labs.

J. L. Richardson.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 687. Price codes: A10 in paper copy, A01 in microfiche. OSW Research and Development Report No. 107, July 1964. 217 p, 57 fig, 16 tab, 168 ref, 6 append. 14-01-0001-297.

Descriptors: \*Desalination, \*Mass transfer, \*Diffusion, \*Thermal properties, Theoretical analysis, Saline water, Sea water, Physical properties, Mathematical studies, Ion transport.

The mechanism of mass transfer in an ionic solution where temperature and concentration gradient coexist was investigated. Theoretical predictions were made of the ordinary and thermal diffusion properties of sea water and saline water. Mass diffusion properties of these saline systems are very dependent on temperature; their variation with concentration is slight. Results indicate that the thermal and ordinary diffusion coefficients of sea water are smaller than those of the saline water at similar conditions of temperature and concentration. Multi-component effects are considerably important in these systems. Theoretical and experimental evidence indicate that ions diffuse at significantly different rates, and sometimes in opposite directions depending on whether the ion is in a binary or multicomponent ionic solution. Thermogravimetric column studies showed that the achievement of appreciable separations of salt from water requires an excessive length of time. Areas requiring further investigation are indicated. (Davison-IPA) W79-05361

#### PARAMETRIC COST STUDIES PERTAINING TO DUAL-PURPOSE POWER AND WATER DESALINATION PLANTS,

Burns and Roe, Inc., New York.

L. Stone, F. J. Patti, M. E. Knebel, W. G. Gerber, and M. Zizza.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 694. Price codes: A07 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 109, 1964. 111 p, 54 fig, 18 tab, 8 ref, 2 append. 14-01-001-345.

Descriptors: \*Desalination plants, \*Multistage flash distillation, \*Nuclear powerplants, Nuclear reactors, Desalination, Desalination processes, Economics, Electric power costs, Water costs, Potable water, Saline water, Electric power production, Optimization, Steam turbines.

The results of an optimization study conducted on the design and economics of multistage flash evaporation plants which produce both potable water and electric power are reported. Water and power production costs were determined for conversion plants with capacities ranging from 7 to 50 mmgd in conjunction with electric power generators driven by steam from nuclear reactors of 40, 70, 120, and 500 MWt. Brine heater temperatures of 250F and 350F were considered, municipal financing rates were used, and electric power was con-

sidered to be sold at production cost. Optimization was also obtained for fossil-fueled plants in the 1 to 14 mmgd range. The unit costs for producing desalinated water in dual-purpose nuclear plants decreased as the reactor power levels increased from 40 to 500 MWt, and fresh water production levels were increased from 7 to 20 mmgd. At the 500 MWt reactor power level there was little change in the unit cost of water for a production range from 20 to 50 mmgd. Unit capital costs rise as water production is decreased, but savings can be effected for a given water production by increasing the reactor power level. The unit cost of electricity was based on the net generation being equal to the gross generation minus the auxiliary power required for the steam and turbine plant. Because the fossil fueled plants were all single purpose plants, they were not comparable to most nuclear plants. (Davison-IPA) W79-05362

#### RESULTS OF SELECTED LABORATORY TESTS OF AN IONICS DEMINERALIZER,

Ionics, Inc., Watertown, MA.

N. W. Rosenberg, T. A. Kirkham, C. E. Tirrell, and N. E. Saliba.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 376. Price codes: A07 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 1, April 1954. 75 p, 35 fig, 14 tab. 14-01-001-52.

Descriptors: \*Desalination, \*Desalination processes, \*Demineralization, \*Water purification, \*Costs, \*Estimated costs, Membranes, Membrane processes, Evaluation, Cost analysis, Ion exchange, Desalination apparatus, Laboratory tests, Equipment, Brackish water, Sea water, Electric currents, Electric power demand, Resistance.

An investigation of the process variables of an ionics membrane demineralizer, an electrical process, as applied to brackish waters from South Dakota, Arizona, and Texas, and sea water and diluted sea water is discussed. Emphasis was directed toward developing an optimum operation technique for minimizing the cost of demineralizing water with this process. The theoretical basis of membrane demineralization and the operation of the experimental unit are discussed. Results of the laboratory operation include information on operating data, voltage-current relations, resistance vs purification, current vs purification, power demand vs product concentration, product concentration vs flow rate, power index vs feed concentration, variation in waste stream flow, hydraulic pressure drop, performance on field samples, electrode efficiencies, ppm reduction, and product water yield. Cost estimates to treat each of the three brackish waters were prepared based on a facility designed to produce 3,280,000 gph with a water quality of 6 epm. The estimates included an estimation of auxiliary equipment required. It is concluded that this process shows sufficient potential to warrant field operation of a larger installation to confirm the estimates of this study. (Davison-IPA) W79-05363

#### DEVELOPMENT OF A DIRECT-FREEZING CONTINUOUS WASH-SEPARATION PROCESS FOR SALINE WATER CONVERSION,

C. M. Bosworth, S. S. Carfango, and D. J. Sandell.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 397.

Price codes: A05 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 23, January 1959. 80 p, 30 fig, 16 tab, 1 append. 14-01-001-86.

Descriptors: \*Desalination, \*Desalination processes, \*Desalination apparatus, \*Freezing, Ice, Ice-brine systems, Equipment, Costs, Cost analysis, Cost comparisons, Economic feasibility, Electric power costs, Operating costs.

The first phase of research evaluating a direct freezer and a counter-current washing separation column is discussed. Ice was produced at a very low temperature using a direct freezer. The temperature difference is one to two degrees F. It was

### Group 3A—Saline Water Conversion



## Conservation In Industry—Group 3E

Descriptors: \*Desalination processes, \*Desalination, \*Desalination apparatus, \*Solvent extraction process, Solvent extractions, Solvents, Solubility, Heterogeneity, Equilibrium, Physical properties, Brackish water, Cost analysis, Sea water, Ethers, Sodium chloride.

Continued research on the solvent extraction process for desalination of sea water is reported. Physical data on a number of solvents is presented. Fundamental consideration was given to primary, secondary, and tertiary amines, and the glycerol and glycol ethers. Solubility in water, density, refractive index, and boiling point are listed, followed by heterogeneous equilibrium data for some of the compounds with water and sodium chloride. The laboratory model of the extraction process was operated to improve the process, and to determine the effect of process variables, including increasing the concentration of waste brine. The results of the operational data were as predicted from the equilibrium and solubility data for the solvents used. Cost equations, based on a 10 mgpd plant, were developed for two solvents under various conditions. It is recommended that the solvent extraction process be studied on a small plant scale using di-isopropylamine as the solvent. It is concluded that this process has certain advantages over other processes being considered for desalination of brackish water with a salt content of 5,000 to 10,000 ppm. (Davison-IPA)

W79-05370

### WEATHERING TESTS OF PLASTICS AND DESIGN OF SUSPENDED ENVELOPE SOLAR STILL

Bjorksten Research Lab., Inc., Madison, WI.  
OSW Research and Development Progress Report No. 30, September 1959. 45 p, 14 fig, 7 tab, 3 ref. 14-01-001-91.

Descriptors: \*Desalination, \*Desalination apparatus, \*Solar stills, \*Solar distillation, \*Plastics, \*Weathering, Exposure, Distillation, Deterioration, Fabrication, Films, Laboratory tests.

An investigation of the resistance of plastic film materials to solar radiation and weathering caused by distillation conditions was carried out with laboratory tests and outdoor exposure tests. Sample containers were developed to protect the specimens of film while they were exposed to distillation conditions. An accelerated testing device was constructed which seemed suitable for rapid screening materials, but direct correlation with outdoor exposure was not established. The testing program was expanded to include preliminary design, construction and testing suspended envelope stills in a modular unit form. The design developed uses commercially available structural elements which require a minimum amount of fabrication into still modules. The available plastic materials with superior resistance to exposure presented problems in effective sealing. Fluorocarbon plastic films were superior in resisting solar distillation conditions, but their high cost and limited availability make it impractical to use them for solar stills. It was found that adhesives or other plastics in contact with the film must be selected for compatibility with it under distillation conditions of solar exposure and humidity. It is concluded that in regions suited for year-round operation of solar stills, the optimum inclination angle for suspended envelope stills tend to equalize the production of product water throughout the year because collection efficiency is increased at low sun angles. (Davison-IPA)

W79-05371

### 3C. Use Of Water Of Impaired Quality

**ABSOLUTE SOLUTION TO INDUSTRIAL WASTE WATER PROBLEM—OUTFALL PREVENTION (DIE ABSOLUTE LOESUNG DES INDUSTRIEABWASSER—PROBLEMS — UNTERBUNDUNG DES ABFLUSSES).**  
For primary bibliographic entry see Field 3E.  
W79-05433

### CONTROLLING IRON OXIDE DEPOSITION IN BOILER SYSTEMS.

Nalco Chemical Co., Chicago, IL.  
J. A. Kelly, and T. R. Filipowski.  
TAPPI Engineering Conference, San Francisco, CA., September 19-21, 1978, Preprinted Proceedings (TAPPI, Atlanta, GA), p 467-481. 13 fig, 13 illus, 8 ref, 6 tab.

Descriptors: \*Boiler feed water, \*Iron oxides, \*Water treatment, \*Corrosion, Industrial water, Pulp wastes, Pulp and paper industry, Effluents, Dissolved oxygen, Deaeration, Iron compounds, Dispersion, Water softening, Demineralization, Boilers, Amines, Condensates, Oxides, Water properties.

The use of high-Btu condensates from the paper machine and other mill areas as feedwater to the power boiler contributes to iron oxide deposition on heat-transfer surfaces. The first approach to combat this problem is to control iron oxide at its source by inhibiting the generation of corrosion products in the condensate system. Chemical control can be accomplished using neutralizing amines for condensate pH elevation and filming for surface protection. Dissolved oxygen, a major corrosion agent, is primarily controlled by mechanical deaeration and residual chemical oxygen scavengers. The second approach is to remove particulate iron oxide from the system by incorporating a condensate polisher to act as a filter. Particulate iron oxide can also be removed from the system after identifying the condensate sources of high iron oxide levels and discontinuing their entry into the boiler feedwater system. The third approach is to chemically control iron oxide deposition in the boiler by using a dispersant, coupled with hardness control agents, to limit particle size growth and inhibit agglomeration. The best results are obtained with a dispersant that interacts with iron oxide in the feedwater and conditions it so that iron oxide transport through the boiler is accomplished. (Swichtenberg-IPC)

W79-05498

### 3E. Conservation In Industry

#### PROCESS FOR PHOSPHATE CONVERSION COATING WITH TREATMENT OF RINSE WATER BY REVERSE OSMOSIS AND ION EXCHANGE.

Nippon Paint Co. Ltd., Osaka (Japan). (Assignee).  
For primary bibliographic entry see Field 5D.  
W79-05372

#### WHITE WATER RECYCLED AT C.I.P. (CANADIAN INTERNATIONAL PAPER CO.), DALHOUSIE, N.B.

International Paper Co., Dalhousie (New Brunswick).  
E. Mercier.

Canadian Pulp and Paper Association Technical Section, Environment Improvement Conference, October 17-19, 1978, Thunder Bay, Ontario, Preprints, p E1-E3. 3 fig, 1 ref. Canadian Pulp and Paper Association, Montreal.

Descriptors: \*Water conservation, \*Pulp and paper industry, \*Recycling, \*White water(Paper machines), Foreign countries, Canada, Water pollution sources, Pulp wastes, Water reuse, Water pollution control, Closed system, Newsprint mills, Groundwood mills, Sulfite pulp mills, Industrial water.

The white water recycling system at the newsprint mill of Canadian International Paper Co. (New Brunswick), in conjunction with the groundwood and sulfite mills, is practically closed, only the second-stage cleaner rejects being sewered. A unique feature is that excess groundwood white water overflows into the sulfite mill white water chest. About 98% of the mixed stock leaves the fourdrinier machines as newsprint or is recycled. The main sources of fiber loss are the paper mill and sulfite mill cleaner rejects as well as come groundwood screen rejects. (Swichtenberg-IPC)

W79-05421

#### EFFECT OF PROCESS WATER RECYCLE ON POLLUTION CONTROL AND ENERGY CONSERVATION.

Consolidated-Bathurst Ltd., Montreal (Quebec).  
Y. M. Mehta.  
Canadian Pulp and Paper Association Technical Section, Environment Improvement Conference, October 17-19, 1978, Thunder Bay, Ontario, Preprints, p D1-D12. 1 append, 13 fig, 6 ref, 6 tab. Canadian Pulp and Paper Association, Montreal.

Descriptors: \*Water pollution control, \*Pulp and paper industry, \*Energy, \*Conservation, \*Waste water treatment, \*Recycling, Pulp wastes, Effluents, Water pollution sources, Water pollution treatment, Foreign countries, Canada, Heat exchangers, Recirculated water, Centrifugation, Industrial water, Instrumentation, Electronic equipment, Particle size, Wastes, Industrial wastes, Newsprint mills, White water(Paper machines).

Pilot-plant and full-scale trials at the newsprint mills of Consolidated-Bathurst Ltd. (Canada) were conducted to evaluate the performance of the Sweco centrifugal screen concentrator. Solids were removed from a waste and pulp thickener filtrates and from pulp machine white water by this cleaning device at an efficiency of 40-60%. Clarified white water is suitable for reuse as shower water and sealing water for vacuum pumps. The Coulter Counter, an electronic device for fine particle size analysis, is used to evaluate the performance of filtration equipment. Heat recovery processes for groundwood effluent streams having suspended solids concentrations up to 2,000 ppm are demonstrated using plate and spiral heat exchangers. (Swichtenberg-IPC)

W79-05422

#### THE IMPACT OF OXYGEN DELIGNIFICATION SYSTEM ON SCREEN ROOM AND BLEACH PLANT EFFLUENTS.

Eddy Forest Products Ltd., Espanola (Ontario).  
C. R. Cook, and J. H. Lund.

Canadian Pulp and Paper Association Technical Section, Environment Improvement Conference, October 17-19, 1978, Thunder Bay, Ontario, Preprints, p C1-C7. 6 fig, Canadian Pulp and Paper Association, Montreal.

Descriptors: \*Bleaching wastes, \*Pulp and paper industry, Wastes, Industrial wastes, Pulp wastes, Water pollution sources, Biochemical oxygen demand, Chemical oxygen demand, Effluents, Hydrogen ion concentration, Water consumption(Except consumptive use), Water conservation, Recycling, Water reuse, Dissolved solids, Oxygen, Oxygen bleaching, Delignification, Kraft mills.

An environmental evaluation is presented of the BOD and COD contents of screen room and bleach plant effluents at the bleached kraft mill of E.B. Eddy Forest Products Ltd. (Ontario). Improvements in pH, dissolved solids losses, and water consumption are noted following the conversion of the CEHD bleach line to an OC/DEHD sequence. Oxygen bleaching was introduced, and the conventional chlorination stage was replaced by a high-temperature C/D stage. The total BOD of the screen room and bleach plant effluents was decreased by 50% and the COD by 30%. Oxygen bleaching reduced water consumption by 400 gal/min in the screen room. The sewered flow from the chlorination stage was reduced from 5,000 gal/min for the old chlorination stage to 1500 gal/min after the installation of a titanium washer which recycles most of the chlorination filtrate. (Swichtenberg-IPC)

W79-05423

#### HIGHLY EFFECTIVE PAPER-MACHINE SHOWER SYSTEMS (VYSOKO-EFFEKTIVNYE SPRYSKOVYE SISTEMY).

Vsesoyuznyi-Nauchnyi Planovii Otdel Bumazhnoi Promyshlennosti, Moscow (USSR).

V. G. Ignatenko, and Ya V. Nikitin.  
Bumazhnaya Promyshlennost', No. 8, p 20-21, August, 1978. 1 tab.

## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3E—Conservation in Industry

Descriptors: \*Water conservation, \*Pulp and paper industry, \*Showers, \*Paper machines, Freshwater, Nozzles, Water pressure, Foreign countries, Water reuse, Recycling, Industrial water, Water pollution control, Water pollution sources, Jets, Wastes, Industrial wastes, Soviet Union (USSR), White water (Paper machines), Wash water.

The efficiency of paper-machine wire showers, in terms of wire cleaning quality and fresh water consumption per meter of wire width, is determined by many factors such as the shape of the nozzle jet, pressure, time of action (continuous or intermittent), and the type of paper manufactured. Efficient shower systems installed at several Soviet paper mills are described. For example, the shower system installed on a newsprint machine at the Kondopoga mill combines low-pressure flat (fan-shaped) jet showers operating continuously and utilizing recycled water, with oscillating high-pressure showers operating intermittently and using fresh water. A comparison of various shower systems operating on paper and board machines indicates that the best means to reduce the consumption of fresh water and to prolong the service life of the machine clothing is to combine low-pressure showers with oscillating high-pressure showers, to use nozzles with fan-shaped jets, and to utilize partially recycle water, such as clarified white water. (Stapinski-IPC)

W79-05430

#### ABSOLUTE SOLUTION TO INDUSTRIAL WASTE WATER PROBLEM—OUTFALL PREVENTION (DIE ABSOLUTE LOESUNG DES INDUSTRIEABWASSER-PROBLEMS — UNTERBINDUNG DES ABFLUSSES),

A. Bruhne.  
Industrieabwasser, p 9-19, June, 1977. 3 fig.

Descriptors: \*Pulp and paper industry, \*Water conservation, \*Water pollution control, Effluents, Water reuse, Recycling, Waste water (Pollution), Waste water treatment, Evaporation, Corrosion, Foaming, Slime, Waste treatment, Economics, Administration, Legal aspects, Waste treatment, Water pollution sources, Pulp wastes, Wastes, Closed systems, Waste paper, Fine papers, Bactericides, Chlorine, White water (Paper machines), Pollution abatement.

Liquid industrial effluents can be prevented entirely by selecting a dry production technology in lieu of a wet process, e.g., air-laid in lieu of water-laid sheet formation (papermaking) or compressed air in lieu of water as a cooling medium. Volumes of discharge effluents (outfall sewers) can be reduced by recycling of process water and concentration of waste water streams by evaporation, etc., with appropriate process modifications to minimize corrosion, foam, slime, and other operating problems. Examples of closed or partly closed water circuits are illustrated, including a paper mill utilizing waste paper. Limitations of this approach are also pointed out, such as the incompatibility of contaminant accumulations (in recycled water) with high quality specifications for fine papers, the need for increased conditioning and clearing of paper-machine felts and wires, the required addition of bactericidal chlorine compounds with attendant intensified corrosivity of the white water, and quality of makeup (stock-dilution, shower, and evaporation-loss) water. Methods of effluent treatment to those from, as well as legal, administrative, and economic considerations in water pollution control are also discussed. (Brown-IPC)

W79-05433

#### BLEACH PLANT OPERATION,

Erco Envirotech Ltd., London (England).  
G. Rowlandson, D. W. Reeve, and W. H. Rapson.  
U.S. Patent No. 4,104,114. August 1, 1978. 10 p, 16 claims. 3 fig.

Descriptors: \*Patents, \*Pulp and paper industry, \*Bleach plants, \*Water conservation, Bleaching wastes, Pulp wastes, Energy, Chemicals, Equipment, Design, Flow, Water, Operation and maintenance, Effluents, Water pollution sources, Water

pollution control, Industrial water, Pollution abatement.

A pulp mill bleach plant including a D/CEDED sequence with a washing step after each stage is operated to provide low effluent volume and a low consumption of water, energy, and chemicals, while providing efficient bleaching, caustic extraction, and washing. Water conservation is practiced by controlling the use of wash water in the bleach plant, controlling the design and operation of washers, deckers, and other mechanical devices used in the bleach plant, and controlling the inflow of water with chemicals. The bleach plant produces two liquid effluents, one acid and one alkaline, and these are passed to a recovery operation. (Lynch-IPC)

W79-05497

### 3F. Conservation in Agriculture

#### MOVEMENT OF PESTICIDES AND NUTRIENTS WITH WATER AND SEDIMENT AS AFFECTED BY TILLAGE PRACTICES: A FIELD STUDY,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 5B.  
W79-05050

#### TRICKLE IRRIGATION TUBING HYDRAULICS,

Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.  
For primary bibliographic entry see Field 8B.  
W79-05061

#### SIMULATED FLOW RATE REQUIREMENTS FOR SOME FLUSHING EMITTERS,

Rain Bird Technical Services, Logan, UT.  
For primary bibliographic entry see Field 8B.  
W79-05062

#### INFLUENCE OF ROW SPACING OF GRAIN SORGHUM ON GROUND COVER, RUNOFF, AND EROSION,

Science and Education Administration, Temple, TX. Grassland, Soil and Water Research Lab. J. E. Adams, C. W. Richardson, and E. Burnett.  
Soil Science Society of America Journal, Vol. 42, No. 6, p 959-962, November-December 1978. 4 fig, 2 tab, 9 ref.

Descriptors: \*Grain sorghum, \*Vegetation effects, \*Runoff, \*Erosion, Farm management, Crops, Sorghum, Canopy, Vegetation, Rainfall, Soil erosion, Light penetration, Agriculture, \*Row spacing, Plant canopy, Ground cover, Row spacing effects.

A study was begun at Temple, Texas, in 1972 to assess the effect of narrow and conventional row spacing of grain sorghum on runoff and erosion from field-sized areas. Sorghum in narrow rows established a more complete plant canopy earlier than sorghum with conventional row spacing and provided more ground cover for much of the growing season. In 1973, runoff was 45% less and soil loss was 39% less from narrow-row grain sorghum than from sorghum with conventional row spacing. Narrow-row spacing of sorghum increased ground cover significantly (5% level) 35 days after emergence in 1974. Canopy cover was at maximum by 63 days after seedling emergence and provided a ground cover of 46 and 81% for sorghum with 100- and 50-cm row spacing, respectively. (Sims-ISWS)

W79-05258

#### WATER PRODUCTION FUNCTIONS FOR IRRIGATED AGRICULTURE,

Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agricultural Economics.  
R. W. Hexem, and E. O. Heady.  
Iowa State University Press, Ames, Iowa, 1978. 215 p, 72 fig, 2 tab, 68 ref.

Descriptors: \*Irrigation, \*Agriculture, \*Crops, \*Production functions, \*Western U.S., Estimating, Irrigation efficiency, Irrigation water, Water management (Applied), Soils, Regional analysis, Fertilizers, Climate, Water allocation (Policy), Mathematical models, Equations, Systems analysis, Optimization, Water demand, Linear programming, Simulation analysis, Water supply, Economics, Planning, Profit maximization, Data, Yield response.

Based on a fairly large number of controlled experiments in the western United States, this book deals with the estimation and application of water production functions. The interest is in more efficient use of water for irrigation and in the need to generalize knowledge of water production in terms of crop yields that could be related to different soils and regions in states relevant to the Bureau of Reclamation's program. Generalized productions were sought to estimate the best farm organization and water use, the yield increases expected, and the relevant charges or repayment schedule to associate with each farm receiving water from an irrigation project. Yield response to water is estimated only in interaction with fertilizer applications. Quantified are environmental variables representing climate and soils, which are incorporated into the estimated production functions. Individual chapters deal with: (1) the role of response functions in management and decisions on water use; (2) production functions and economic applications; (3) features of selected production functions; (4) procedures for estimating production functions; (5) origin and features of the research project; (6) analysis of corn, wheat, and cotton experiments; (7) single product and canonical joint product functions for sugar beets; (8) generalized production functions; (9) derived demand functions for water; (10) product supply functions; and (11) programmed water demands. (Bell-Graf-Cornell)

W79-05275

#### A SOLAR-POWERED PUMP FOR IRRIGATION,

Battelle Columbus Labs., OH.  
G. H. Alexander.

In: Proceedings, Irrigation Association 1978 Technical Conference, Cincinnati, February 26-28, 1978. Irrigation Assoc., Silver Spring, MD., 1978, p 1-19. 8 fig.

Descriptors: \*Pumps, Pumping plants, \*Irrigation.

A solar-powered irrigation pump designed for the Northwestern Mutual Life Insurance Company has been in experimental and developmental operation at Paloma Ranch near Gila Bend, Arizona, since April 1977. An objective of this program was to design and construct a prototype 35- to 50-horsepower solar-energy pumping system to evaluate its applicability in a working irrigation environment. The range includes approximately 22,000 irrigated acres; the yearly energy bill for pumping water is approximately \$1.5 million. (Skogerboe-Colorado State)

W79-05287

#### ENERGY AND IRRIGATION,

Shell Chemical Co., Houston, TX.  
J. S. Ostermeyer.

In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. p 20-27, 1978.

Descriptors: Energy, \*Irrigation, Irrigated agriculture, Irrigation practices, Fertilizers, Nuclear energy.

This paper reviews the energy situation in the United States and how the energy shortage is going to affect the national economy, thereby, the irrigated agriculture. It also suggests the directions of a sound national energy policy to deal with the situation and recommends better farm management practices to reduce the cost of energy in irrigated agriculture. (Skogerboe-Colorado State)

W79-05288

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## Conservation In Agriculture—Group 3F

**SOLID STATE CONTROL SYSTEMS FOR IRRIGATION,**

Solar Wind Systems, Inc., San Rafael, CA.  
M. B. Marian.

In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. p. 35-37, 1978.

Descriptors: Irrigation programs, \*Irrigation scheduling, Control systems, \*Automatic control, Computer programs.

This paper discusses the basic principles of solid state control systems, causes of failure or malfunction of the systems, customer's responsibilities to insure proper functioning, and their applicabilities in irrigation scheduling. Further, it discusses three basic ways to program an irrigation controller and recommends the use of removable media such as programming with a mark sense card. (Skogerboe-Colorado State)  
W79-05289

**ELECTRICAL LOAD AND WATER MANAGEMENT,**

Science and Education Administration, Fort Collins, CO.

D. F. Heermann, and H. R. Duke.

In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 60-67, 4 fig. 9 ref.

Descriptors: Load distribution, \*Electric power demand, Peak loads, \*Sprinkler irrigation.

The objective is first, to review the presently used techniques for reducing peak demands on electrical systems, second, to examine a technique for improving the water management of center pivot sprinkler systems and, third, to explore the integration of load management and water management. An analysis of these aspects led to the conclusion that an integrated load and water management control system offers significant cost savings to today's irrigator. (Skogerboe-Colorado State)  
W79-05290

**CENTER PIVOTS ON SOILS MARGINALLY SUITED FOR IRRIGATION IN MANITOBA, CANADA,**

Manitoba Univ., Winnipeg. Dept. of Agricultural Engineering.  
F. F. Penkava.

In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, OH, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 68-75, 3 fig 7 ref.

Descriptors: \*Sprinkler irrigation, Irrigation effects, Soil classification, Crop production, Soil erosion, Runoff, Potatoes.

The Almasippi series soils of Manitoba have poor moisture holding capacity and high groundwater tables. In spite of those very serious disadvantages irrigated potato production will likely expand on the Almasippi soils. In order to acquire more knowledge on the proper use of center pivot irrigation and on the possible problems and measures for their elimination, a research project was initiated in the spring of 1977 on two localities on which center pivot units were just being installed. The following preliminary conclusions were made based on the research findings: (1) Center pivots, or any other irrigation systems used on the Almasippi series soils in Manitoba must be carefully designed and operated; (2) Single applications should not exceed 20 mm; (3) Application intensities must be carefully balanced with infiltration capacities of the soils and no credit must be given to surface water detention; (4) In carbonated areas application intensity should not exceed 5 mm per hour (0.2 inch/hr); (5) Oversized center pivot units with high precipitation intensities near the end tower should not be used; (6) Random subsurface drainage should be used to control the groundwater levels in the depressions; and (7) Research

should continue under real irrigation conditions. (Skogerboe-Colorado State)  
W79-05291

**ECONOMICS OF IRRIGATION,**

Nebraska Univ., Lincoln. Dept. of Agricultural Economics.  
L. F. Sheffield.

In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 76-90, 5 fig, 7 tab.

Descriptors: \*Sprinkler irrigation, \*Economic impact, Irrigation, Irrigated land, Cost analysis, Corn belt, Great Plains.

This paper reviews and discusses the accelerated growth of irrigated agriculture with center pivot irrigation systems in the Great Plains Region in the 1970's, and the reasons behind the severity and widespread effects of the current cost-price squeeze on farmers and agri-business community. A detailed analysis of the economics of irrigation leads to the conclusion that irrigated agriculture and the irrigation industry in the United States face a bright future despite its present temporary problems. (Skogerboe-Colorado State)  
W79-05292

**APPLICATION OF END GUNS ON CENTER PIVOTS,**

Nelson Irrigation Corp., Grand Island, NE.

R. E. Hanson.

In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 91-103.

Descriptors: \*Sprinkler irrigation, Uniformity coefficient, Distribution patterns, Application equipment, Crop production.

The main factors probably considered by the pivot irrigator in selecting the use of end guns are the favorable cost per acre and obtaining the maximum corner coverage. Use of end guns in combination with corner covering type systems, end gun sizes in combination and larger end guns have been more recent adaptations on center pivots to extend the corner coverage. Many factors affect the corner coverage obtainable with an end gun. Some of these factors can only be determined through a complete system design for the conditions. Selection of the end gun for the system conditions are based primarily on the gun performance, are setting, pressure, trajectory angle and nozzle size. Proper application of end guns generally involves the same field, soil, crop, climatic and water supply conditions that must be considered in center pivot application. In addition to obtaining maximum effective corner coverage, other considerations are uniformity of application, droplet impact conditions and application rate. The factors affecting these considerations in the use of end guns on center pivot systems are discussed. (Skogerboe-Colorado State)  
W79-05293

**LIMITS OF LOW PRESSURE SPRINKLERS AND SPRAY NOZZLES ON CENTER PIVOT APPLICATIONS,**

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.  
J. R. Gilley.

In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 104-115.

Descriptors: \*Sprinkler irrigation, Limiting factors, Nozzles, Application equipment, Uniformity coefficient, Pressure head, Irrigation efficiency, Runoff, Soil erosion.

Low pressure center pivot irrigation systems offer the potential of applying irrigation water with significant energy savings. However, lowering the pressure of center pivot systems may create poten-

tial problems of runoff and soil erosion, uniformity of water application and operation. The future use of low pressure systems is dependent upon the solutions to these problems. In some cases low pressure systems should not be used. This paper presents an analysis and discussion of the effects of lower pressures on center pivot applications. (Skogerboe-Colorado State)  
W79-05294

**SCHEDULING OF WATER AND NITROGEN FOR CORN IN THE HUMID MIDWEST,**

Michigan State Univ., East Lansing. Dept. of Crop and Soil Science.

M. L. Vitosh.

In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 116-123. 1 fig, 4 tab, 11 ref.

Descriptors: \*Scheduling, Irrigation, Sweet corn, Nitrogen, Fertilization, Humid climates, Michigan, \*Irrigation practice.

This study was conducted in Michigan on irrigated sandy soils where irrigation of corn is a relatively new practice compared to the semi-arid regions. It was recommended that application rate should not exceed 30% of the water holding capacity in the effective rooting zone since the optimum soil moisture level for corn is usually between 50 and 80% of the available water holding capacity. This will prevent or minimize the leaching of nitrate-nitrogen from the rooting zone in the event of rain. Adequate moisture must be available at the end of the growing season to carry the crop to maturity. Further, it was recommended to apply approximately (a) one-third of the total N requirement for the crop as a preplant incorporated or pre-emergence with a herbicide; (b) one-third sidedress or pre-emergence if the first third was applied preplant; and (c) one-third through the irrigation system which should be applied prior to pollination. (Skogerboe-Colorado State)  
W79-05295

**THE ROLE OF SPRINKLER IRRIGATION IN PRODUCING SPECIALTY CROPS,**

Patterson Farms, China Grove, NC.

C. Patterson.

In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 124-125.

Descriptors: \*Sprinkler irrigation, Frost protection, Freezing, Tomatoes, Strawberries, North Carolina.

The benefits of using a solid set sprinkler irrigation system for frost and freeze protection of tomato and strawberry production in North Carolina were discussed. (Skogerboe-Colorado State)  
W79-05296

**FACTORS INFLUENCING SYSTEM SELECTION IN HUMID REGIONS,**

Auburn Univ., AL. Cooperative Extension Service.  
L. M. Curtis.

In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 126-130. 5 fig.

Descriptors: Irrigation, Humid areas, \*Humid climates, Southeast United States, Irrigation systems, \*Sprinkler irrigation.

Factors and difficulties that should be evaluated in considering cable tow and center pivot irrigation systems on farms in the Southeast United States were discussed. The following factors have been analyzed: (1) water supply; (2) topography and surface characteristics; (3) crops grown and rotation schemes; and (4) economic considerations. It was concluded that the factors influencing system selection in the Southeast are numerous. The less favorable factors may slow or prohibit develop-



## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3F—Conservation in Agriculture

ment of irrigation in some areas. However, continued expansion of irrigated cropland appears likely as farmers incorporate irrigation as a production or management tool in their overall farming operation. (Skogerboe-Colorado State)  
W79-05297

#### THE USE OF OVERTREE IRRIGATION FOR CROP COOLING AND FROST AND FREEZE PROTECTION ON APPLES,

North Carolina State Univ. at Raleigh. Dept. of Horticultural Science.  
C. R. Unrath, and R. E. Sneed.  
In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, MD. 1978. p 131-134.

Descriptors: \*Sprinkler irrigation, Cooling, Freezing, \*Frost protection, Apples, Peaches, Fruit crops, North Carolina.

Overtree irrigation for apple orchard cooling is an effective method of microclimate modification resulting in markedly improved fruit quality and greater grower returns. The experimental results showed that the evaporative cooling resulted in increased fruit coloration of red varieties' apples and increased sugar content, fruit size and reduced incidence of cork spot and bitter pit. The application rates of 0.16 in/hr to 0.18 in/hr were effective and provide higher water use efficiency than lower application rates. Overtree irrigation for frost and freeze protection was also evaluated and application rates between 0.16 in/hr to 0.18 in/hr were recommended for protection against 18 degrees to 20 degrees F conditions. (Skogerboe-Colorado State)  
W79-05298

#### OPTIMIZING TRAVELING SPRINKLER SYSTEM PERFORMANCE,

Nelson Irrigation Corp., Walla Walla, WA.  
B. Ruper.  
In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., p 152-159, Silver Spring, Md. 1978. 5 fig, 1 tab.

Descriptors: \*Sprinkler irrigation, Uniformity coefficient, Application equipment, Pressure head, Distribution pattern, Wind velocity.

Many factors affect the proper performance of traveling sprinkler irrigation systems. Among the most important considerations are uniformity of application, water droplet conditions and the application rate of the system. Test data, as well as actual field experience, confirm that a high degree of uniformity is achievable with a traveler, as long as proper lane spacing and travel direction are utilized, as well as proper arc setting and pressure. Acceptable droplet conditions can be achieved only through the use of adequate pressure and proper selection of trajectory angle for a given nozzle size. Application rates for travelers are sufficiently low to make them adaptable for most soil conditions. (Skogerboe-Colorado State)  
W79-05299

#### INTRODUCTION TO IRRIGATION EFFICIENCY AND SCHEDULING,

California Univ., Parlier. Cooperative Extension. F. K. Aljibury.  
In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 160-161, 1 tab.

Descriptors: \*Irrigation efficiency, Scheduling, Water shortage, \*Sprinkler irrigation, Consumptive use.

The subject of rational use of water is of vital interest. The allocation of existing supplies of water is becoming difficult and controversial. Irrigation efficiency and scheduling concepts play important roles in this context. Terms used to de-

scribe irrigation and water use efficiency are defined. (Skogerboe-Colorado State)  
W79-05300

#### SOCIETAL ATTITUDES AND RESULTANT POLICIES CALL FOR WATER CONSERVATION,

California Univ., Davis. Dept. of Land, Air and Water Resources.  
R. M. Hagan.  
In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 162-179.

Descriptors: \*Water conservation, \*Social aspects, Social impact, Social participation, Water policy, \*Irrigation practices, Irrigation efficiency, Evapotranspiration, California.

The water situation and, to some extent, societal attitudes have changed dramatically in California within the past few months. This paper briefly touches on a number of aspects in order to provide a sample of the kinds of thoughts being expressed about irrigation agriculture, especially by environmental leaders. Several points are covered in some detail. (Skogerboe-Colorado State)  
W79-05301

#### WATER EFFICIENCY WITH DEFICIT AND SUBOPTIMAL IRRIGATION,

California Univ., Parlier. Cooperative Extension. F. K. Aljibury, M. Gerdt, and J. Beutel.  
In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, OH, February 26-28, 1978. Irrigation Assoc., Silver Spring, MD. 1978. p 180-182, 3 tab.

Descriptors: Cultural control, Water shortage, Water conservation, \*Furrow irrigation, Fruit crops, Irrigation systems, Irrigation efficiency, California.

Irrigation is considered one of the most important cultural practices in the arid and semi-arid irrigated areas of the world. The increasing demand for water and its limited supplies requires maximum efficiency in its use for irrigation. To achieve this end, many water specialists and plant scientists have been conducting studies to determine the effect of deficit irrigation on the production of food and fibrous crops. The objectives of such experiments are to maximize production under conditions of drought or limited water supplies. From experimental results it is concluded that the effect of deficit irrigation by furrow irrigation on the early growth of the plum trees was not significant. The deficit irrigation did not cause unusual leaf abscission or premature fruit drop. Total production was not affected but water savings was significant. The effect of deficit water treatments in the drip irrigated plots, on the soil water potential and deep moisture extraction was very evident. These irrigations did not affect the number of fruits per tree and bud initiation of future seasons significantly but produced fruits of smaller size. (Skogerboe-Colorado State)  
W79-05302

#### COMPARATIVE EFFICIENCY OF IRRIGATION SYSTEMS,

Oregon State Univ., Corvallis.  
M. N. Shearer.  
In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, MD. 1978. p 183-188, 4 fig, 2 tab.

Descriptors: \*Irrigation efficiency, Irrigation systems, Uniformity coefficient, \*Sprinkler irrigation, Surface irrigation, Seepage, Runoff, Evaporation.

The purpose is to compare efficiencies obtainable with various irrigation systems having reasonably good designs. Also, several concepts of field irrigation efficiency have been discussed. (Skogerboe-Colorado State)  
W79-05303

#### IRRIGATION EFFICIENCY IN SCHEDULING,

Cornell Pump Co., Portland, OR.  
G. Tribe.  
In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. p. 189-191, 1978.

Descriptors: \*Pumps, Pumping plants, Pump testing, Efficiencies, Design criteria.

Testing and experimentation have proven that a pump's ability to convert rotating kinetic energy to hydraulic pressure energy is predictable. This energy conversion efficiency can be improved by the application of engineering fundamentals. This paper discusses the need for improving pump efficiency and the factors which must be considered for improved pump design and to reduce the cost of ownership. (Skogerboe-Colorado State)  
W79-05304

#### AUTOMATION OF SURFACE IRRIGATION,

Nebraska Univ., Clay Center. South Central Station.  
D. E. Eisenhauer, and P. E. Fischbach.  
In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 196-205, 1 fig, 4 tab, 7 ref.

Descriptors: \*Surface irrigation, \*Automation, Automatic control, Irrigation efficiency, Irrigation systems, \*Cost comparisons, Nebraska.

Efficient and low labor irrigation systems appear to be the way of the future. Automation of conventional gated pipe systems is a good way of improving efficiency and yet holding down labor requirements. The main additional component of the automatic system is the automatic valve. One valve is on the market now and another will be available soon. Design of automatic systems involves properly sizing pipeline and other components, using normal engineering criteria, plus designing for the proper field length and furrow stream size. Annual costs of automatic gated pipe is higher than conventional gated pipe systems, but recent trends in automatic sprinkler systems suggest that farmers are willing to invest the extra capital to reduce labor demands. (Skogerboe-Colorado State)  
W79-05305

#### PRACTICAL SURFACE IRRIGATION,

West Side Pump Co., Los Palos, CA.  
R. Gosling.  
In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 206-208.

Descriptors: \*Surface irrigation, Sprinkler irrigation, Irrigation systems, Automation, Cost comparisons, Flexibility, California.

This paper discusses and makes a comparative analysis of gated pipe surface irrigation systems with respect to other systems. (Skogerboe-Colorado State)  
W79-05306

#### MEASURING EFFICIENCY OF SURFACE IRRIGATION SYSTEMS,

Bennett and Bennett Irrigation Pipe Co., Hanford, CA.  
S. C. Robinson.  
In: Proceedings, Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 209-212.

Descriptors: \*Surface irrigation, \*Irrigation efficiency, Application methods, Application equipment, Return flow, Irrigation systems, Border irrigation, Furrow irrigation, Sprinkler irrigation.

The concept of irrigation efficiency, the definition of application efficiency, and the various components of efficiency measurement of surface irriga-

tion systems were discussed. Rules were outlined which could be used in field applications to attain high application efficiency of surface irrigation systems. (Skogerboe-Colorado State) W79-05307

#### **SOLAR CELL IRRIGATION,** Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.

P. E. Fischbach, and R. W. Matlin.  
In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 213-217, 1 fig, 2 tab.

Descriptors: \*Irrigation, \*Solar energy, Energy conversion, \*Irrigation systems, Surface irrigation, Automation, Computer programs, Irrigation programs, Nebraska, Application equipment.

A large solar cell-powered crop irrigation system has been constructed on the University of Nebraska field laboratory in Mead, Nebraska. Success of the experimental irrigation system could demonstrate an alternate source of energy for irrigation. The photovoltaic cells used in the project, how they converted the solar energy to electrical energy and how the 80 acre-irrigation project was run and managed by the system were discussed. (Skogerboe-Colorado State) W79-05308

#### **EVALUATION CRITERIA FOR TRICKLE IRRIGATION EMISSION DEVICES,**

Rain Bird Technical Services, Logan, UT.  
K. Solomon.  
In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 218-223, 4 ref.

Descriptors: \*Trickle irrigation, \*Irrigation systems, Tricking filters, Clogging, Pressure head, Variability, Costs, Risks.

The emission device is sometimes referred to as the heart of a trickle irrigation system. It is important to compare the different types of emission devices available in order to choose wisely from among possible alternatives. This paper suggested and discussed some of the factors to be considered when judging and comparing emission devices. The following seven fundamental factors should be examined to select a particular emission device to use in a system: (1) General suitability; (2) Pressure-flow relationships; (3) manufacturing variability; (4) Flow rate sensitivity to water temperature; (5) Sensitivity to clogging; (6) Cost and (7) Risk. Some of these can be considered engineering performance factors, and hence can be measured and evaluated only subjectively. (Skogerboe-Colorado State) W79-05309

#### **TRICKLE DESIGN FOR MIDWEST CONDITIONS,** Farm Bureau Services, Inc., Hart, MI.

J. Gamble.  
In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 226-230.

Descriptors: \*Trickle irrigation, Irrigation systems, Irrigation design, Clogging, Pipelines, Water shortage, Water conservation.

This paper discussed trickle irrigation design concepts, water resources used for this system in the midwest United States, and installation and operation criteria for such a system. Current problems facing the users and/or the installer of the system were also discussed. (Skogerboe-Colorado State) W79-05310

#### **TRICKLE IRRIGATION IN HUMID ZONES,** Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering.

H. J. Braud.

In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 231-238, 2 fig, 2 tab, 6 ref.

Descriptors: Irrigation systems, \*Trickle irrigation, Irrigation design, \*Humid areas, Louisiana, Productivity, Citrus fruits, Sugarcane.

The need for irrigation in a humid area is specific to the particular crop-soil-climate. Not all crops respond to irrigation: Citrus does, but not sugarcane in Louisiana. Work group meetings of scientists interested or involved in trickle irrigation were held last year to define the most important problems of trickle irrigation. A regional research project draft was written. 'Trickle Irrigation in Humid Regions,' with the following objectives: (1) To determine water requirements and water management techniques; (2) To develop best procedures for applying N, P and K; (3) To determine causes of clogging in humid regions and develop methods to minimize it; (4) To optimize crop management practices; (5) To determine water and nutrient flow patterns and related root development; (6) To examine the costs, returns and profitability of trickle irrigation. Research on trickle is underway or planned at 17 state agricultural experiment stations and United States Department of Agriculture, Agricultural Research Service research stations. (Skogerboe-Colorado State) W79-05311

#### **BACTERIAL CLOGGING IN LOW PRESSURE IRRIGATION SYSTEMS,**

Agricultural Research and Education Center, Lake Alfred, FL.  
H. W. Ford.

In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Silver Spring, Md. 1978. p. 239-244, 2 fig, 7 ref.

Descriptors: \*Irrigation systems, Low-flow augmentation, Clogging, Irrigation, \*Bacteria, Slime.

Bacterial slimes are the fundamental cause of most clogging problems. There are no types of low pressure irrigation systems immune to slime clogging. Chlorine, when used in combination with suitable filtration, will control most of the slimes and associated agents that clog irrigation emitters. Chlorine, like other pesticides, requires a special use label in order to be used in drip irrigation systems. (Skogerboe-Colorado State) W79-05312

#### **IA SPRINKLER TEST STANDARDS,**

Johns-Manville Sales Corp., Fresno, CA. Ag-Turf Div.

D. A. Bruce.  
In: Proceedings Irrigation Association, 1978 Technical Conference, Cincinnati, Ohio, February 26-28, 1978. Irrigation Assoc., Silver Spring, Md. 1978. p. 282-289, 2 tab.

Descriptors: \*Sprinkler irrigation, Testing procedures, Standards, Testing, Performance.

After many years of discussion, rejection and frustration, the irrigation industry is on the threshold of adopting a uniform method of testing sprinklers, collecting test data and reporting product performance. This paper outlines the sprinkler test procedure developed by a working committee formed by The Irrigation Association. The IA is attempting to issue a joint standard with the American Society of Agricultural Engineers. (Skogerboe-Colorado State) W79-05313

#### **EFFECT OF SOIL HUMIDITY ON NITRATE REDUCTASE ACTIVITY IN BARLEY SHOOT LEAVES (IN RUSSIAN),**

Leningrad State Pedagogical Inst. (USSR).  
For primary bibliographic entry see Field 2I.  
W79-05314

#### **CONTROL SYSTEM FOR IRRIGATION PUMPS,**

J. J. Bode.  
U.S. Patent No. 4,130,382, 5 p, 5 fig, 10 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 3, p 837, December 19, 1978.

Descriptors: \*Patents, \*Irrigation systems, \*Irrigation efficiency, \*Control systems, Rain, Pumps, Electronic equipment, Rain activated control systems.

A rain activated control system shuts off an irrigation pump when a predetermined amount of rainfall occurs. A receptacle for catching rain is mounted in a manner to provide adjustment of the distance between its bottom and a pair of electrodes which extend into the receptacle. When rain is collected in the receptacle in sufficient quantity to immerse the electrodes, a control circuit is completed to operate a relay. The energized relay then activates the shut down system of the engine or motor which drives the irrigation pump. After a time delay sufficient to assure complete shut down of the pump, a timing circuit causes deenergization of the relay and closes a reset circuit. When the irrigation pump is to be restarted, the rain receptacle is emptied and a reset switch is opened to reset the control circuitry. (Sinha-OEIS) W79-05373

#### **SPRAY NOZZLE,**

Senninger Irrigation, Inc., Orlando, FL. (Assignee).

M. Healy.  
U.S. Patent No. 4,130,247, 4 p, 3 fig, 9 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 3, p 792, December 19, 1978.

Descriptors: \*Patents, \*Irrigation, \*Sprinkler irrigation, \*Application equipment, Irrigation practices, Irrigation efficiency, Nozzles.

A spray nozzle apparatus and a method of making a spray nozzle in which a variety of nozzle sizes can be made using several common components is described. The nozzle head had a threaded base for attachment to a water line which base has an opening passing through for mounting removable nozzle inserts with retainer rings. A water-deflecting portion is mounted to the base so that a curved portion will deflect water at a predetermined angle. The curved deflector is attached to the base with a single screw and a pair of positioning studs. The invention is directed towards a spray nozzle producing a flat spray which is made of a polymer material and thus provides a surface which acts partially as a solid lubricant and having some small amount of resilience. (Sinha-OEIS) W79-05374

#### **AUTOMATIC LIQUID FLOW CONTROL DEVICE,**

D. D. Moore.  
U.S. Patent No. 4,130,135, 5 p, 4 fig, 2 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 3, p 755, December 19, 1978.

Descriptors: \*Patents, \*Irrigation, \*Controls, \*Flow control, Irrigation practices, Irrigation efficiency, Application equipment, Valves, Automatic control.

The automatic liquid flow control valve includes a waterwheel and a timer which can be set to start or stop the waterwheel at a predetermined time. The waterwheel is located within a liquid-tight valve housing. The valve housing includes an inlet and outlet. Both the inlet and the outlet may comprise coupling means for mounting the valve in a liquid supply line. The waterwheel, when held in a stationary position, prevents liquid from passing through the housing. When the waterwheel is allowed to rotate liquid will freely flow through the housing. The invention is specifically designed to be used as part of a system for watering gardens, lawns or fields. The device allows irrigation at night with the flow of water being started or stopped or, alternatively, started and then stopped at a predetermined time or times. (Sinha-OEIS)



## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3F—Conservation in Agriculture

W79-05375

#### WIND CORRECTION METHOD AND APPARATUS FOR IRRIGATION SYSTEMS,

Reinke Manufacturing Company, Deshler, NE. (Assignee).

R. J. Coash.

U.S. Patent No. 4,128,205, 6 p, 8 fig, 5 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 1, p. 115, December 5, 1978.

Descriptors: \*Patents, \*Irrigation, \*Sprinkler irrigation, \*Wind, Irrigation efficiency, Irrigation practices, Application equipment, Wind sensor.

A device controls the discharge of liquid from an elevated spray head according to the wind conditions. A wind sensor is mounted near the end of an irrigation boom or other elevated pipe. An end spray head for the boom is controlled by a motor driven valve. When the sensor detects wind along the boom above a selected velocity, a circuit is activated to operate the valve motor in a manner to turn the spray head off or on, depending on the wind direction. The circuit includes time delays relays which disregard sudden gusts of wind. (Sinha-OEIS)

W79-05379

#### WATER DRIVE SYSTEM FOR A CENTER PIVOT IRRIGATION UNIT OR THE LIKE,

Lindsay Mfg. Co., NE. (Assignee).

K. E. Arndt, L. E. Otto, Jr., and D. A. Siekmeier. U.S. Patent No. 4,127,181, 10 p, 7 fig, 8 ref; Official Gazette of the United States Patent Office, Vol. 976, No. 4, p. 1157, November 28, 1978.

Descriptors: \*Patents, \*Irrigation, \*Irrigation systems, Application equipment, Irrigation efficiency, Irrigation practices, Hydraulics.

A water drive system for a center pivot irrigation system has a string of pipe which pivots in a circle or oscillates about a center pivot or upright. The pipe is supported on towers at intervals and each tower is independently driven by a power mechanism which is operated by the pressure of the water in the string of pipe. The system includes a mechanism to prevent one or more of the towers from rolling ahead on a downhill slope, a diaphragm valve arrangement for controlling the cycling of the drive, and an enlarged bellows or bladder for operating the water drive mechanism. (Sinha-OEIS)

W79-05387

#### IRRIGATION APPARATUS,

G. Gilead.

U.S. Patent No. 4,126,998, 5 p, 9 fig, 17 ref; Official Gazette of the United States Patent Office, Vol. 976, No. 4, p. 1096, November 28, 1978.

Descriptors: \*Patents, \*Irrigation, \*Irrigation systems, \*Subsurface irrigation, Application equipment, Irrigation efficiency, Irrigation practices.

Irrigation apparatus comprises first and second layers of sheet material, at least one of the first and second layers being configured in relief and the first and second layers being bonded together at touching surfaces so that the bonding defines a liquid conduit. There is at least one pressure reducing path associated with it and an exit port from each of the pressure reducing path associated with it and an exit port from each of the pressure reducing paths. Fluid flows through the primary flow conduit, into the pressure reducing path and exits in a trickle through an exit port. (Sinha-OEIS)

W79-05389

THE ECONOMIC VALUE OF IRRIGATION WATER IN THE WESTERN UNITED STATES: AN APPLICATION OF RIDGE REGRESSION, Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology. For primary bibliographic entry see Field 6B.

W79-05399

## 4. WATER QUANTITY MANAGEMENT AND CONTROL

### 4A. Control Of Water On The Surface

#### DRAINAGE DENSITY AT INDEX OF WATERSHED DEVELOPMENT,

Rice Univ., Houston, TX. Dept. of Environmental Engineering.

P. B. Bedient, W. C. Huber, and J. P. Heaney. Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 104, No. IR4, Proceedings Paper 14249, p 373-387, December 1978. 6 fig, 6 tab, 22 ref.

Descriptors: \*Drainage density, \*Environmental effects, \*Florida, \*Land use, \*Drainage programs, Water pollution sources, Water quality, Data collections, Watershed management, Phosphorus, Geomorphology, Drainage patterns (Geologic), \*South Florida, \*Kissimmee River Basin, \*Lake Okeechobee Basin, Stream geometry.

A methodology was presented to predict environmental impacts using drainage characteristics of developing watersheds in South Florida. These watersheds have been undergoing extreme changes in land use, drainage patterns, and water quality levels. An effort was made to quantify changes in drainage density, a measure of the total length of water courses per unit area of watershed, over the period 1953-1972 and to relate it to various parameters of watershed development. The use of 1:24,000 scale aerial photographs provided the measure of drainage network in the Kissimmee River Basin. It was found that increased drainage between 1953-1972 had produced a 223% increase in drainage density in the Lake Okeechobee Basin, due largely to artificial drainage activities. Concentrations and loading rates of total phosphorus from tributaries along the river were correlated with drainage density, and they indicate that the majority of the load is produced in intensively ditched areas. (Singh-ISWS)

W79-05034

#### TRANSIENT SUBSURFACE DRAINAGE ON SLOPING IRRIGATED LAND,

Bechtel, Inc., San Francisco, CA.

For primary bibliographic entry see Field 6A.

W79-05052

#### CONTROLLING IRRIGATION RUNOFF LOSSES WITH PROPER MANAGEMENT,

Idaho Univ., Moscow. Dept. of Agricultural Engineering.

D. W. Fitzsimmons, J. R. Busch, G. C. Lewis, and C. W. Berg.

Paper No. 78-2090, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 14 p, 1 fig, 9 tab, 8 ref. ASAE, St Joseph Michigan.

Descriptors: \*Surface runoff, Runoff, Tailwater, Erosion, Surface irrigation, Water loss, Sediment control, Nutrient removal, Irrigation effects.

Field investigations to determine the effectiveness of irrigation, tillage and other practices in controlling surface runoff and resulting pollutant losses from surface-irrigated fields were conducted during two irrigation seasons. The results indicate that water, sediment and nutrient losses can be reduced or eliminated by the use of proper management practices. (Skogerboe-Colorado State)

W79-05059

#### LAND USE EFFECTS ON CLAYPAN SOIL HYDROLOGY,

Science and Education Administration, Columbia, MO. North Central Watershed Research Center. L. A. Kramer, and R. E. Burwell.

Paper No. 78-2070, Presented at the 1978 Summer Meeting of the American Society of Agricultural

Engineers, June 27-30, 1978, Logan, Utah, 14 p, 7 tab, 5 ref. ASAE, St. Joseph, Michigan.

Descriptors: \*Land use, Water yield, Land management, Clays, \*Surface runoff, Corn, Wheat, Following, Pastures.

Water yield data from 0.02-acre research plots for a ten-year study period of constant land use treatments are presented. The SCS Curve Number Procedure for runoff prediction gave ten-year average annual runoff values very similar to the observed land cover of fallow, continuous corn, small grain, and rotation meadow. (Skogerboe-Colorado State)

W79-05063

#### INTERACTING EFFECTS OF MINIMUM FLOW AND FLUCTUATING SHORELINES ON BENTHIC STREAM INSECTS,

Idaho Univ., Moscow. Dept. of Entomology.

For primary bibliographic entry see Field 2E.

W79-05233

#### ALGAE AND WATER POLLUTION,

For primary bibliographic entry see Field 5C.

W79-05322

#### OUTPUT OF WATER, SUSPENDED SEDIMENT, AND PHOSPHORUS FORMS FROM A SMALL AGRICULTURAL CATCHMENT, Marlborough Catchment and Regional Water Board, Blenheim, (New Zealand).

For primary bibliographic entry see Field 5B.

W79-05344

#### SOME ASPECTS OF SEDIMENT DISTRIBUTION AND MACROPHYTE CYCLING OF HEAVY METALS,

Purdue Univ., Lafayette, IN. Dept. of Bionucleonics.

For primary bibliographic entry see Field 5C.

W79-05353

#### FLOW MEASUREMENT,

K. W. Martig, Jr.

U.S. Patent No. 4,127,030, 6 p, 3 fig, 2 ref; Official Gazette of the United States Patent Office, Vol. 976, No. 4, p. 1106, November 28, 1978.

Descriptors: \*Patents, \*Flow, \*Flow measurement, Closed conduit flow, Flow rates, Flow characteristics, Flow depth.

Liquid flow through a sewer or water pipe or conduit is measured by admitting the liquid into a confining region of known dimensions from an open end of the pipe or conduit at such rate as to maintain the liquid depth constant in the pipe or conduit and determining the volume of liquid entering the region within a given time period. The depth in the pipe or conduit is conveniently monitored as static pressure of liquid, as is the depth in the confining region. Air is ducted from the confining region as necessary to ensure admission of the liquid at the desired rate for constant in-pipe depth. (Sinha-OEIS)

W79-05388

#### KENNEBEC RIVER CORRIDOR PLAN - A MANAGEMENT PLAN FOR A REJUVENATED RESOURCE,

North Kennebec Regional Planning Commission, Winslow, ME.

For primary bibliographic entry see Field 6B.

W79-05402

#### KENNEBEC RIVER CORRIDOR PROJECT - APPENDIX II: WATER RESOURCES,

North Kennebec Regional Planning Commission, Winslow, ME.

For primary bibliographic entry see Field 6B.

W79-05404



## Effects On Water Of Man's Non-Water Activities—Group 4C

**KENNEBEC RIVER CORRIDOR PROJECT — APPENDIX III: FLOW REGULATION**, North Kennebec Regional Planning Commission, Winslow, ME.  
For primary bibliographic entry see Field 6B.  
W79-05405

**KENNEBEC RIVER CORRIDOR PROJECT — APPENDIX IV: FLOODING**, North Kennebec Regional Planning Commission, Winslow, ME.  
For primary bibliographic entry see Field 6B.  
W79-05406

**KENNEBEC RIVER CORRIDOR PROJECT — APPENDIX V: MANAGEMENT PLAN**, North Kennebec Regional Planning Commission, Winslow, ME.  
For primary bibliographic entry see Field 6B.  
W79-05407

**VARIABILITY OF ANNUAL NUTRIENT AND SEDIMENT DISCHARGES IN RUNOFF FROM OKLAHOMA CROPLAND AND RANGELAND**, Agricultural Research Service, Durant, OK. Water Quality Management Lab.  
For primary bibliographic entry see Field 5C.  
W79-05429

#### 4B. Groundwater Management

**SUBSURFACE DRAINAGE OF AN ALLUVIAL CLAY SOIL FOR SOYBEANS**, Science and Education Administration, Baton Rouge, LA.  
C. E. Carter, and C. R. Camp.  
Paper No. 78-2040, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 6 p, 3 fig, 2 tab, 7 ref. ASAE, St. Joseph, Michigan.

Descriptors: \*Subsurface drainage, Subsurface drains, Soybeans, \*Crop response, Crop production, Clays, Louisiana.

A subsurface drainage field experiment was conducted on a 4 ha site of an alluvial clay soil in Tensas Parish, Louisiana, during 1974-1977. Subsurface drains spaced 7.5 and 15 m apart did not effectively control the water table but the soil water regime near the drains was improved somewhat. Soybean yields were significantly increased by this improved drainage three of four years with drains spaced 7.5 m apart and two of four years with drains spaced 15 m apart. (Skogerboe-Colorado State)  
W79-05053

**ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1977 TO SPRING 1978**, Geological Survey, Tucson, AZ. Water Resources Div.  
Geological Survey Water-Resources Investigations 78-144 (open-file report), November 1978. 2 sheets, 23 ref.

Descriptors: \*Arizona, \*Groundwater, \*Maps, \*Water levels, \*Pumping, \*Drawdown, Irrigation, Water yield, Groundwater availability, Water supply.

The withdrawal of ground water was about 5.5 million acre-feet in Arizona in 1977. About 4.7 million acre-feet of ground water was used for the irrigation of crops in 1977. The Salt River Valley and the lower Santa Cruz basin are the largest agricultural areas in the State. For 1973-77, ground-water withdrawal in the two areas was about 8.1 and 5.1 million acre-feet, respectively, and, in general, water levels are declining. Other areas in which ground-water withdrawals have caused water-level declines are the Wilcox, San Simon, upper Santa Cruz, Avra Valley, Gila Bend, Harquahala Plains, and McMullen Valley areas. Two small-scale maps of Arizona show (1) pum-

page of ground water by areas and (2) the status of the ground-water inventory in the State. The main map, scale 1:500,000, shows potential well production, depth to water in selected wells in spring 1978, and change in water level in selected wells from 1973 to 1978. The brief text that accompanies the maps summarizes the current ground-water conditions in the State. (Woodard-USGS)  
W79-05151

**SUMMARY APPRAISALS OF THE NATION'S GROUND-WATER RESOURCES—MISSOURI BASIN REGION**, Geological Survey, Lakewood, CO. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W79-05152

**QUANTITATIVE HYDROGEOLOGY OF THE UPPER REPUBLICAN NATURAL RESOURCES DISTRICT, SOUTHWEST NEBRASKA**, Geological Survey, Lincoln, NE. Water Resources Div.  
E. G. Lappala.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-288 135, Price codes: A10 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-38, June 1978. 200 p, 41 fig, 10 plates, 81 ref.

Descriptors: \*Groundwater mining, \*Irrigation wells, \*Withdrawal, \*Drawdown, \*Model studies, Computer models, Projections, Surface-groundwater relationships, Surface waters, Hydrogeology, Soil water movement, Vegetation, Aquifers, Groundwater recharge, Water level fluctuations, Groundwater availability, Water demand, Evaluation, \*Nebraska, \*Ogallala formation.

Ground-water use for irrigation from the Ogallala Formation has increased rapidly in the Upper Republican Natural Resources District in southwest Nebraska. Water levels declined as much as 16 feet between 1952 and 1975. Discharge of the aquifer to streams was reduced by as much as 19 percent between 1967 and 1975. Quantification of the hydrogeologic system was provided by the development, testing and use of simulation models describing the soil zone and ground-water/surface-water system. Models were linked through source-sink terms. The ground-water/surface-water model was used to predict changes in water levels and streamflow caused by unrestricted irrigation-well installation and by no new wells after 1975. Water levels may decline as much as 140 feet in two areas by 2000 if installation of new wells is unrestricted. By 2000, water-level declines over the remainder of the area would be less than 60 feet under continued development and less than 40 feet with no new wells after 1975. The base flow of Frenchman, Stinking Water, and Spring Creeks could be reduced by more than 90 percent with no new wells and eliminated by 1992 under continued development. (Woodard-USGS)  
W79-05161

**ARTIFICIAL RECHARGE ON LONG ISLAND, NEW YORK**, Geological Survey, Syosset, NY. Water Resources Div.  
D. A. Aronson.  
Long Island Water Resources Bulletin LIWR-9, 1978. 25 p, 9 fig, 1 tab, 38 ref.

Descriptors: \*Artificial recharge, \*Groundwater recharge, \*Injection wells, \*Reclaimed water, \*Ponding, Water reuse, Water quality, Water management (Applied), New York, \*Long Island.

In eastern and central Long Island, N.Y., the ground-water supply has been diminished by the demands of continued population growth and the loss of replenishment since the advent of sewerage. In addition, the quality of ground water is threatened locally by the discharge of effluents from septic tanks, cesspools, and industries and by saltwater intrusion near the shorelines as a result of heavy pumping. The use of highly treated

wastewater (reclaimed water) to replenish the ground-water supply on Long Island seems to be both feasible and economical. Two methods that have been tested are injection of reclaimed water into the ground through wells, and ponding it in basins for infiltration to the water table. Major hindrances to these methods are well clogging by suspended particles in the injectant and clogging of the infiltration surface of the basin. Both can be controlled by adequate treatment of reclaimed water prior to recharge and by proper maintenance of infiltration surfaces. (Woodard-USGS)  
W79-05169

**DEFINING UPPER LIMITS TO GROUND-WATER DEVELOPMENT IN THE ARID WEST**, Montana State Univ., Bozeman.  
O. R. Burt, R. G. Cummings, and J. W. McFarland.  
American Journal of Agricultural Economics, Vol 59, No 5, p 943-947, December 1977. 2 tab, 5 eq, 9 ref.

Descriptors: \*Groundwater development, \*Optimum development plans, \*Steady-state level, Water withdrawal, Groundwater storage, Methodology, Natural resources, Groundwater supply, Dynamic optimization, Information feedback, Costs, Annual, Linear programming, Polynomial, Agriculture, Income, Economic rate, Systems analysis, Conceptual model.

Groundwater development over the past twenty years in the western states has almost consistently followed a pattern of overdevelopment. The result has been rapid mining and thus depletion of the stock. This paper asserts that this problem might be avoided, or perhaps diminished, if at the outset groundwater development plans were considered in the context of the optimal steady-state level for groundwater stocks and rates of natural recharge. The 'optimal steady-state stock' is the level of groundwater storage at which mining optimally ceases and withdrawals become limited to natural recharge. Developed is a general methodology for determining such steady-state levels in natural resource systems; data from a case study of groundwater use in the Estancia Valley (New Mexico) are used to exemplify the usefulness of the approach. It is shown that it is possible to calculate the dynamic optimization problem's steady-state stock without going through the dynamic optimization process. The lines of argument developed parallel the general philosophy that underlies adaptive control processes developed in recent years; this refers to the information 'feedback' that can occur over time with operational experience. Thus, in the case of groundwater development, one begins with limited hydrologic information which is often based on general information as to geological formulations. Elementary hydrologic information is obtained only as drilling and pumping take place. Thus early estimates for groundwater storage must be viewed as tentative and subject to modification as additional data become available, implying the need for relatively simple and flexible computational techniques. (Bell Graf-Cornell)  
W79-05271

#### 4C. Effects On Water Of Man's Non-Water Activities

**ANALYSIS OF URBAN STORM-WATER-QUALITY FROM SEVEN BASINS NEAR PORTLAND, OREGON**, Geological Survey, Portland, OR. Water Resources Div.  
For primary bibliographic entry see Field 5B.  
W79-05156

**RECONNAISSANCE ASSESSMENT OF EROSION AND SEDIMENTATION IN THE CANADA DE LOS ALAMOS BASIN, LOS ANGELES AND VENTURA COUNTIES, CALIFORNIA**, Geological Survey, Menlo Park, CA. Water Re-

## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4C—Effects On Water Of Man's Non-Water Activities

sources Div.

For primary bibliographic entry see Field 2J.  
W79-05172

**COASTAL MORPHOLOGY, OIL SPILL VULNERABILITY AND SEDIMENTOLOGY OF KOTZEBUE SOUND AND KODIAK ISLAND, South Carolina Univ., Columbia. Dept. of Geology.**

For primary bibliographic entry see Field 5C.  
W79-05213

**THE EFFECTS OF OIL ON TEMPERATURE REGULATION IN SEA OTTERS, Scripps Institution of Oceanography, La Jolla, CA. Physiological Research Lab.**

For primary bibliographic entry see Field 5C.  
W79-05214

**EVALUATION OF THE EFFECTS OF URBANIZATION ON STORMWATER RUNOFF AND QUALITY, Tennessee Univ., Knoxville. Dept. of Civil Engineering.**

D. E. Overton, R. A. Minear, W. L. Troxler, R. S. Brown, and E. C. Crosby.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 513. Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Center, University of Tennessee, Research Report No. 65, September 1978. 184 p. OWRT A-046-TENN(3). 14-34-0001-8045.

**Descriptors:** Watershed hydrology, Mathematical models, \*Storm runoff, \*Urbanization, Urban watersheds, Nonpoint pollution, Heavy metals, Minerals, Nutrients.

Results of analysis of stormwater runoff and quality from four small urban watersheds in Knoxville, Tennessee, are presented in two parts: Part 1 is on Stormwater Hydrographs and Part 2 is on Stormwater Quality. A third part presents the mathematical models developed in the course of the study for simulating storm hydrographs, suspended sediment pollutographs and loads, and sediment delivery ratios. There is apparently a wide range of effects of dustfall and urban stormwater quality on a contaminant-by-contaminant basis. Certain constituents such as COD, Hg, Cl, Pb, SiO<sub>2</sub>, PO<sub>4</sub>, and As significantly influence stormwater quality. Likewise COD, Hg, Cl, As, and PO<sub>4</sub> levels found in the stormwater were caused primarily by dust-fall. The relative magnitude of the constituents will have to be verified by further study. This verification would logically lead to the potential control of pollutants by: controlling the source of air contaminants, better sanitary street practices to collect the contaminants before they enter the water, and treatment after they enter the water system. Results from the removal model indicate that basically, there are two distinct but overlapping groups of contaminants found in the urban watershed. One group is the minerals and solids which have relatively constant concentrations from storm to storm and the other group is heavy metals, nutrients, and COD which have decreasing concentration with increasing runoff.

W79-05400

#### 4D. Watershed Protection

**BIOLOGICAL ASSESSMENT OF TIMBER MANAGEMENT ACTIVITY IMPACTS AND BUFFER STRIP EFFECTIVENESS ON NATIONAL FORESTS STREAMS OF NORTHERN CALIFORNIA, California Univ., Berkeley. Dept. of Forestry and Conservation.**

For primary bibliographic entry see Field 5C.  
W79-05005

**PREDICTION OF SOIL LOSS ON CROPLAND WITH REMOTE SENSING, Texas Christian Univ., Fort Worth. Dept. of Geol-**

ogy.

For primary bibliographic entry see Field 7B.  
W79-05148

**SUMMARY OF WATERSHED CONDITIONS IN THE VICINITY OF REDWOOD NATIONAL PARK, CALIFORNIA, Geological Survey, Menlo Park, CA. Water Resources Div.**

R. J. Janda.  
Geological Survey open-file report 78-25, 1977. 82 p, 12 fig, 2 tab, 28 ref, append.

**Descriptors:** \*Erosion, \*Erosion control, \*Land use, \*Lumbering, \*Sediment transport, Channel erosion, Channel morphology, Landslides, Floods, Storms, Aggradation, California, \*Redwood National Park, \*Redwood Creek.

The Redwood Creek Unit of Redwood National Park, Calif., is located in the downstream end of an exceptionally rapidly eroding drainage basin. Although intense storms control the timing and general magnitude of major erosion events, the movement, types, and amounts of erosion occurring during those events are substantially influenced by land use. Erosional impacts of past timber harvest in the basin reflect primarily the cumulative impact of many small erosion problems caused not so much by removal of standing timber as by the pattern of ground surface disruption accompanying removal. Recently modified riparian and aquatic environments reflect stream channel adjustments to recently increased water and sediment discharges, and are classified by the National Park Service as damaged resources because the modifications reflect, in part, unnatural causes. Natural debris barriers along stream flowing through remaining old-growth forest have temporarily stored substantial quantities of sediment introduced into streams by recent storms and upstream land-use changes. Removal of merchantable timber from these barriers may destroy their stability and cause rapid release of stored sediment. Additionally, massive erosion in some recently harvested areas suggest that they are so erosionally sensitive that following rehabilitation and reforestation, they should not be reharvested. (Woodard-USGS)

W79-05170

**SILT BARRIERS AS EROSION POLLUTION CONTROL IN A LARGE RECREATIONAL LAKE, Federal Highway Administration, Tallahassee, FL. Florida Div.**

E. G. Rivers, and C. J. Allen.  
In: Mitigating Adverse Environmental Effects of Highway Construction; Transportation Research Record 551, p 12-24, 1975. 12 fig, 2 tab, 15 ref.

**Descriptors:** \*Erosion control, \*Lakes, \*Environmental effects, \*Highways, \*Florida, Silts, Road construction, Pollutants, Soil erosion, Barriers, On-site investigations, Turbidity, Sedimentation, Sampling, Evaluation, Analysis, Water pollution sources, Lake sediments, On-site data collections, \*Lake Jackson (FL), Silt barriers, Floating silt barriers.

Soil erosion from urban development and Interstate highway construction during the winter and spring of 1972 and 1973 resulted in extensive runoff pollution of Lake Jackson, a large recreational lake in northern Florida. Turbidity levels in mid-lake reached levels of 180 Jackson turbidity units, and portions of the lake reached turbidity levels exceeding 500 Jackson turbidity units. Floating silt barriers we deployed in 2 arms of the lake by the Florida Department of Transportation to abate the movement of turbid waters into the main body of the lake. Sediment core analyses were performed to determine the extent of sedimentation that had occurred, and water turbidity was monitored to determine the effectiveness of the silt barriers. Clay and silt fines were found to be the major factor in creating turbid conditions in the lake. Erosion controls were effective in controlling movement of sand-size sediments, but they were ineffective in controlling clays and silts. The silt barriers were up to 93% effective in preventing the movement of

suspended silt and clay into the main body of the lake. Floating silt barriers can be a significant tool in confining suspended solids to localized areas in aquatic environs. However, silt barriers should not be relied on as a sole means to control erosion pollution. (See also W79-05235) (Humphreys-ISWS)

W79-05237

**BETTER GRASSES FOR ROADSIDES, Rutgers - The State Univ., New Brunswick, NJ. Dept. of Soils and Crops.**

For primary bibliographic entry see Field 6G.  
W79-05238

## 5. WATER QUALITY MANAGEMENT AND PROTECTION

### 5A. Identification Of Pollutants

**SOME RESULTS FROM RECENT CHEMICAL STUDIES AT KILAUEA VOLCANO, HAWAII, Hawaii Univ., Honolulu. Dept. of Chemistry. J. J. Naughton, J. B. Finlayson, and V. A. Lewis. Bulletin Volcanologique, Vol. 39, No. 1, p 64-69, Jan 1975. 2 fig, 7 ref. OWRT A-046-HI(1).**

**Descriptors:** \*Volcanoes, Hawaii, Fume.

The chemical surveillance of Kilauea volcano, Hawaii, has continued. No relationship has thus far been identified between the helium content of an associated fumarole and the activity at the volcano. Fume samples from Halemaumau crater in Kilauea caldera and from a fissure eruption that occurred nearby on the floor of the caldera during August 1971 were examined for their halogen (Cl and F) and sulfur contents. The ratio of Cl/F in fume showed an abnormal increase in samples taken at Halemaumau a month before the eruption. This change in ratio may be a helpful indicator of the onset of eruption in volcanic areas.

W79-05003

**FUME COMPOSITIONS FOUND AT VARIOUS STAGES OF ACTIVITY AT KILAUEA VOLCANO, HAWAII, Hawaii Univ., Honolulu. Dept. of Chemistry. J. J. Naughton, V. Lewis, D. Thomas, and J. B. Finlayson.**

Journal of Geophysical Research, Vol. 80, No. 21, p 2963-2966, July 20, 1975. 1 fig, 2 tab, 22 ref. OWRT A-046-HI(2).

**Descriptors:** \*Volcanoes, Hawaii, Fume.

Fume was collected at Kilauea Volcano with equipment patterned after that used in industrial pollution studies. Particulates and some of the gases present were separated. The fume analyzed was collected from Halemaumau crater in a non-eruptive state, from Mauna Ulu lava lake with mild lava fountaining, and from vigorous but short-lived fountaining from fissures across the floor of Kilauea caldera. The chief components were SO<sub>2</sub>, SO<sub>4</sub>, Cl, Na, Ca, K, F, Mg, and Fe in about that order of decreasing concentration. Content and order of abundance varied depending on the state of activity of the volcanic sources of the fume. Sulfur compounds were preponderant.

W79-05004

**DEVELOPMENT AND EVALUATION OF A TWO-STEP MEMBRANE FILTER METHOD FOR FECAL COLIFORM RECOVERY IN CHLORINATED SEWAGE EFFLUENTS, Illinois State Water Survey, Urbana. S. D. Lin.**

Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 146. Price codes: A02 in paper copy, A01 in microfiche. Report of Investigation 87, 1978. 14 p, 6 fig, 9 tab, 28 ref.

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## Identification Of Pollutants—Group 5A

**Descriptors:** \*Sewage effluents, \*Testing procedures, \*Coliforms, \*Laboratory tests, Analytical techniques, Analysis, Chlorination, Sewage treatment, Filters, Membranes, Water pollution sources, Waste water (Pollution), Bacteria, Sewage bacteria, Fecal coliform, Bacteria analysis, Chlorinated wastewater effluents, Membrane filter method.

The standard one-step M-FC broth membrane filter (MF) procedure for recovery of fecal coliform (FC) in chlorinated wastewater effluents is much less effective than the multiple-tube (most probable number, MPN) technique. A two-step MF method was developed. Using a pre-enrichment technique with phenol red lactose broth and incubation at 35°C for 4 hours, followed by plating on M-FC agar and incubation at 44.5°C for another 18 + or - 2 hours, enhanced FC recovery in chlorinated effluents. The results of 126 comparisons using chlorinated effluents from five wastewater plants showed that FC recovery with the two-step MF method is comparable to that with the MPN procedure. In the development of the two-step MF method for FC recovery in chlorinated effluents, only the Millipore HC filters were used. Literature shows that different bacteria recovery capabilities are reported for various membranes. Therefore, nine other types of membranes were compared with Millipore HC for their fecal coliform recovery in chlorinated effluents from the five wastewater treatment plants. The results of 61 comparisons were analyzed by Duncan's multiple range test. The 10 membranes can be divided into four groups. Millipore HC, Gelman GN-6, and Sartorius SM 138 06 (green) are equivalent and give the highest FC recovery in chlorinated effluents. The next group is Helena Titan GH, Nuclepore N 040, Sartorius SM-137 56, and Schleicher and Schuell (S and S) BC 07. Johns-Manville (J-M) sterilized and S and S B-9 belong to the other group and have an FC recovery better than J-M radiation. The J-M radiation gives the lowest FC recovery rate in chlorinated effluents. In all, 1002 blue colonies from all types of filters were isolated for fecal coliform verification. Average verification was 93.2%. (Humphreys-ISWS) W79-05012

**SYSTEMATIC DIURNAL CURVE ANALYSIS.** Hickok (Eugene A.) Associates, Wayzata, MN. For primary bibliographic entry see Field 5B. W79-05042

**A GEOGRAPHICALLY VARIABLE WATER QUALITY INDEX USED IN OREGON.** Oregon State Dept. of Environmental Quality, Salem. Water Quality Div. For primary bibliographic entry see Field 5B. W79-05043

**COPPER, NICKEL, AND ZINC RELEASED FROM ACID COAL MINE SPOIL MATERIALS OF EASTERN KENTUCKY.** Kentucky Univ., Lexington. Div. of Regulatory Services. H. F. Massey, and R. I. Barnhisel. Soil Science, Vol. 113, No. 3, p 207-212, 1972. 4 tab, 14 ref.

**Descriptors:** \*Strip mines, \*Appalachian Mountain region, \*Toxicity, \*Soil chemical properties, \*Kentucky, Copper, Nickel, Zinc, Mine wastes, \*Pollutant identification.

Toxicity from copper, nickel and zinc may be a problem in revegetating coal mine spoil banks. Concentrations of zinc, copper and nickel as high as 145, 85 and 122 ppm respectively were found in spoil solution. (Curtis-Forest Service) W79-05044

**INFLUENCE OF DILUTION WATER ON THE TOXICITY OF KRAFT PULP AND PAPER MILL EFFLUENT, INCLUDING MECHANISMS OF EFFECT.** British Columbia Research Council, Vancouver. Div. of Applied Biology. D. J. McLeay, C. C. Walden, and J. R. Munro.

Water Research, Vol. 13, p 151-158, 1979. 4 fig, 4 tab, 27 ref.

**Descriptors:** \*Pulp wastes, \*Toxicity, \*Hydrogen ion concentration, Industrial wastes, Chemical wastes, Resins, Acids, Bleaching wastes, Pulp and paper industry, Bioassay, Rainbow trout, Mortality, Juvenile growth stage, Methodology, \*Dehydroabietic acid.

Ten natural freshwater samples differing widely in pH and other characteristics were collected and examined for their influence as dilution waters on the acute lethality (24-h LC50 values) of a sample of bleached kraft whole mill effluent. When bioassays were conducted at the pH of each dilution water, LC50 values varied by 3.5-fold. These differences were largely accounted for by adjustment of the pH of each test solution to a common value (6.5). The remaining minor differences in LC50 values were attributed to the ionizable inorganic constituents of the dilution waters. A separate study examined the effects of test pH and the involvement of aging of solutions prior to bioassays or of pH overshoots during pH adjustment on the toxicity of a second sample of pulp mill effluent; using a single dilution water. The LC50 values obtained for bioassays conducted at pH 9.5 were significantly higher than those for tests performed at pH 6.5. Neither the adjustment of test solutions to pH 9.5 with immediate readjustment to pH 6.5, nor the prior aging of solutions at pH or 6.5 with minimal or no aeration for 6h, altered the differences due to test pH. (Deal-EIS) W79-05105

#### THE NATURE OF METALS-SEDIMENT-WATER INTERACTIONS IN FRESHWATER BODIES, WITH EMPHASIS ON THE ROLE OF ORGANIC MATTER.

Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia). Petroleum Exploration Branch. K. S. Jackson, I. R. Jonasson, and G. B. Skippen. Earth-Science Reviews, Vol. 14, p 97-146, 1978. 6 fig, 2 tab, 227 ref.

**Descriptors:** \*Metals, \*Sediments, \*Organic matter, Humic acids, Fulvic acids, Geochemistry, Organic compounds, Ions, Chemical reactions, Chemical properties, Chemical analysis, Heavy metals, Adsorption, \*Copper, \*Cobalt, \*Zinc, \*Mercury, \*Nickel, \*Lead, Manganese, Magnesium, Path of pollutants, \*Ligands.

The review is divided into two main sections, viz, nature and properties of humic matter, and water-metal-sediment interactions. The first section deals with the essential properties of organic matter which occurs naturally in drainage sediments and waters. Discussion of the basic molecular structure of humic and fulvic acids is followed by some details of the chemical nature of functional groups within these structures which are important in metal-ion adsorption and complexing reactions which these materials can undergo. Information is also presented for colloidal and polyelectrolyte properties, complexation properties, and finally a summary discussion of metal-ion-humic-acid, metal-ion-fulvic-acid stability constants for both single ligand and mixed ligand systems completes the section. The second section comprises discussions of some specific aspects of interactions between metals, sediments and waters, including metal and organic speciation studies; sorption interactions between organic matter, clays and humic acids; chemical reaction between humic acids, heavy-metal minerals, clays and other silicate minerals; metal-ion adsorption-desorption studies, oxidation-reduction reactions between metal ions and humic acids; effects of sulphide ion on some of the above interactions and finally a summary of some relevant field geochemical dispersion studies. (Deal-EIS) W79-05106

**TOXICITY OF COPPER TO CUTTHROAT TROUT (SALMO CLARK) UNDER DIFFERENT CONDITIONS OF ALKALINITY, PH, AND HARDNESS.**

Maine Univ. at Farmington. Dept. of Chemistry. C. Chakoumakos, R. C. Russo, and R. V. Thurston.

Environmental Science and Technology, Vol. 13, No. 2, p 213-219, 1979. 2 fig, 8 tab, 31 ref.

**Descriptors:** \*Cutthroat trout, \*Copper, \*Toxicity, Bioassay, Rainbow trout, Fish physiology, Alkalinity, Hardness (Water), Hydrogen ion concentration, Copper compounds, Ions, Alkalis (Bases), Chemical analysis, Chemical properties, Water chemistry, Carbonates.

Median lethal concentration (96-h LC50) values for acute copper toxicity to 3-10g cutthroat trout have been determined for nine different combinations of alkalinity, hardness, and pH. Equilibrium calculations were performed on the copper LC50 values. Seven different soluble species of copper were considered:  $\text{Cu}^{2+}$ ,  $\text{CuOH}^{+}$ ,  $\text{Cu(OH)}_2$ ,  $\text{Cu}_2(\text{OH})_2^{2+}$ ,  $\text{CuHCO}_3^{+}$ ,  $\text{CuCO}_3$ , and  $\text{Cu(CO}_3)_2^{2-}$ . The acute toxicity of copper was inversely correlated with water hardness and alkalinity. At a given alkalinity, hardness determined the LC50; at a given hardness, alkalinity determined the LC50. At a given alkalinity and hardness, the concentrations of the copper species were determined by the pH of the water. Under the conditions tested,  $\text{Cu}^{2+}$ ,  $\text{CuOH}^{+}$ ,  $\text{Cu(OH)}_2$ , and  $\text{Cu}_2(\text{OH})_2^{2+}$  were toxic forms of copper to cutthroat trout;  $\text{CuHCO}_3^{+}$ ,  $\text{CuCO}_3$ , and  $\text{Cu(CO}_3)_2^{2-}$  were not toxic. Results of 11 96-h copper toxicity bioassays on 1- to 26-g rainbow trout under uniform water chemistry conditions are also reported. (Deal-EIS) W79-05107

#### TROPHIC LEVEL ACCUMULATION OF HEAVY METALS IN A COAL ASH BASIN DRAINAGE SYSTEM.

Texas Univ. Health Science Center at Houston. School of Public Health. R. K. Guthrie, and D. S. Cherry. Water Resources Bulletin, Vol. 15, No. 1, p 244-248, 1979. 1 fig, 1 tab, 8 ref.

**Descriptors:** \*Absorption, \*Heavy metals, \*Trophic level, Coals, Copper, Zinc, Cadmium, Aluminum, Iron, Chemical analysis, Neutron activation analysis, Water chemistry, Mercury, Food chains, Diptera, Sediments, Drainage systems, Crayfish, Livebearers, \*Bioaccumulation, \*Tissue analysis, \*Selenium, \*Barium, \*Coal ash.

The uptake of ten chemical elements was measured in water, sediment, fly ash, and the major biotic components of an ash basin drainage system. The biota tested represent several trophic levels observed in the settling basin and receiving swamp of the system. Concentrations were measured by neutron activation in the major biotic groups including aquatic bacteria, algae, macrophytes, midges, dragonflies, crayfish, tadpoles, and fish. Only three elements (Cu, Zn, Cd) were more highly concentrated in water from a nearby unpolluted stream than in the fly ash effluent. Sediment concentrations of all elements were highest in the ash drainage system with Al and Fe being consistently highest. Among the biota, *Hydrodictyon* sp. and *Lemna perpusilla* had the highest concentrations of Al and Fe while other macrophytes were the major accumulators of Mn and Ba. Invertebrates generally concentrated high amounts of Cu and Zn although Cd and Hg were accumulated most by crayfish. Selenium was selectively concentrated by bacteria, crayfish (*Procambarus* sp.) and mosquitofish (*Gambusia affinis*). Consequences of elemental concentrations in sediment and in specific trophic level groups are discussed. (Deal-EIS) W79-05108

#### THE USE OF SPECIES ABUNDANCE ESTIMATES IN MARINE BENTHIC STUDIES.

Maine Univ., Walpole. Ira C. Darling Center for Research, Teaching and Service. L. Watling, P. C. Kinner, and D. Maurer. Journal of Experimental Marine Biology and Ecology, Vol. 35, p 109-118, 1978. 6 tab, 17 ref.



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

Descriptors: \*Mathematical studies, \*Benthic flora, \*Plant populations, Analytical techniques, Bottom sampling, Dredging, Bottom sediments, Biological communities, Sampling, Plant groupings, Estimating equations, \*Species diversity, Species diversity indices.

The application of species abundance estimates, commonly used in terrestrial plant ecology, to marine benthic dredge data is advocated. Two possible scales were tested for their ability to measure adequately the structure of an assemblage by computing measures of evenness diversity. McNaughton's dominance index, and Morisita's index of dispersion using both real counts obtained from grab samples and these counts transformed into the two respective abundance estimates. It is concluded that species abundance estimators, when applied to grab or dredge data result in significant savings in sample processing time with only a minimal loss of information about assemblage structure. (Deal-EIS)  
W79-05109

**ANALYSIS OF CHLORINATED HYDROCARBON POLLUTANTS: A SIMPLIFIED EXTRACTION AND CLEANUP PROCEDURE FOR FISHERY PRODUCTS.**  
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.  
V. F. Stout, and F. L. Beezhold.  
Fishery Bulletin, Vol. 76, No. 4, p. 880-886, 1979. 5 ref.

Descriptors: \*Chemical analysis, \*Chlorinated hydrocarbon pesticides, DDT, DDE, Polychlorinated biphenyls, Dieldrin, Chemical degradation, Laboratory tests, Analytical techniques, Chromatography, Chemical reactions, Aroclors, \*Tissue analysis.

This paper is a laboratory manual, delineating details of a simple, rapid, and reliable method for the extraction and cleanup of samples of fish, fishery products, and paper for analysis of chlorinated hydrocarbons, such as PCB, dieldrin, and DDT and its metabolites TDE and DDE. The procedures can be adapted to a great variety of sample types. The method is economical since small amounts of solvents are used and the equipment and glassware are relatively inexpensive and readily available. (Deal-EIS)  
W79-05110

**A BIOASSAY LABORATORY BOAT WITH COMPARISONS OF CENTRAL VS. BOAT LABORATORY BIOASSAY EVALUATIONS.**  
Academy of Natural Sciences of Philadelphia, PA. Div. of Limnology and Ecology.  
A. Scheier, W. Connell, and H. D. Gominger.  
Water Resources Bulletin, Vol. 15, No. 1, p. 75-87, 1979. 4 fig, 6 tab, 9 ref.

Descriptors: \*Oil pollution, \*Toxicity, \*Bioassay, \*On-site data collections, Research equipment, Oil, Organic compounds, Sunfishes, Channel catfish, Snails, Shrimp, Minnows, Chemical analysis, Chemical properties, Chemical reactions, Irradiation, Chemical degradation.

A laboratory boat designed to investigate toxic effects on site and its use as a bioassay tool in the study of a refinery effluent discharged into the Schuylkill River, a tributary of the Delaware River, is described. Three-hundred thirty-six-hour continuous-flow bioassays exposing the bluegill sunfish, the channel catfish, the tadpole snail, the grass shrimp, and the sheepshead minnow to concentrations of refinery effluent in Schuylkill, Delaware River, and Delaware Bay water, with and without the addition of sediment were performed. Results indicated that the toxicity (lethality) of fresh samples tested aboard the boat (refinery effluent, dilution water, sediment) were considerably higher (i.e., refinery effluent at full strength was 2.2X as lethal to the bluegill, 1.4X as lethal to the channel catfish, 1.5X as lethal to the sheepshead minnow and 100X as lethal to the grass shrimp) than the same test material collected from the refinery outfall and brought to a central laboratory

for testing. Chemical analysis and bioassay data is presented showing the effects of aging and irradiation upon the refinery effluent. (Deal-EIS)  
W79-05111

**METHODS FOR DETERMINING THE OXYGEN CONSUMPTION OF A FISH UNDER CONDITIONS OF AQUATIC SEMI-CONFINEMENT (METHODES DE DETERMINATION DE LA CONSOMMATION D'OXYGENE D'UN POISSON DANS LES CONDITIONS DU SEMI-CONFINEMENT AQUATIQUE).**  
Amiens Univ. (France). Lab. de Physiologie.  
J. Gorin, M. Freville, B. Dercumaux, and P. Harichaux.  
Annales de Hydrobiologie, Vol. 8, No. 3, p. 355-362, 1977. 3 fig, 5 ref.

Descriptors: \*Oxygen requirements, \*Oxygen, \*Chemical analysis, Fish physiology, Animal metabolism, Mathematical studies, Mathematical models, Laboratory tests, Analytical techniques, Water chemistry, Water analysis, Methodology.

Under conditions of aquatic semi-confinement, including a system of water renewal and a slight stirring, the oxygen consumption of a fish can be determined by registration of the variations of the oxygen partial pressure in the environment according to time. Two methods are set forth, the first one is based on graphic records and the second one results from a mathematical development. (Deal-EIS)  
W79-05112

**AN EVALUATION OF THE STATUS, LIFE HISTORY, AND HABITAT REQUIREMENTS OF THE ENDANGERED AND THREATENED FISHES OF THE UPPER COLORADO RIVER SYSTEM. PART TWO.**  
Ecology Consultants, Inc., Fort Collins, CO.  
T. Joseph, J. Sinning, R. Bihlke, and P. Holden.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-279 545, Price codes: A09 in paper copy, A01 in microfiche. Fish and Wildlife Service, U.S. Department of the Interior, Report No. FWS/OBS-77/62, 193 p, 1977. 10 fig, 3 tab, 1 append, 134 ref.

Descriptors: \*Colorado River, \*Fish populations, Colorado River Basin, Water utilization, Water allocation(Policy), Reservoirs, Flow, Habitats, Ecosystems, Water quality, Dams, Trout, Cut-throat trout, Suckers, Lumbering, Mining, Water chemistry, Salinity, Suspended solids, Life history studies, \*Endangered species.

The focus of this report is the endangered and threatened fishes of the Upper Colorado River system, but a full appreciation would not be possible without an adequate knowledge of the ecosystems in which they live. The six major sections of the report are: abiotic components, biological components, species description, river basin descriptions, major factors inducing environmental change, and urgent needs and recommended research priorities in regard to the upper Colorado River System. (Deal-EIS)  
W79-05114

**HEAVY METAL CONCENTRATIONS AT THE APEX OF THE NEW YORK BIGHT.**  
National Oceanic and Atmospheric Administration, Boulder, CO. Marine Ecosystems Analysis Program Office.  
J. E. Alexander, R. Hollman, and T. White.  
NOAA Technical Memorandum ERL MESA-34, December 1978. 37 p, 11 fig, 15 tab, 26 ref, append.

Descriptors: \*Heavy metals, \*Pollutants, \*New York, Cadmium, Cobalt, Copper, Iron, Lead, Mercury, Zinc, Nickel, Pollutant identification, New York Bight.

Particulate and total 'soluble' cadmium, cobalt, copper, iron, and lead, and total 'soluble' mercury concentrations were determined for 146 seawater samples collected on November 8-9, 1973, in the apex of the New York Bight. With few exceptions,

particulate lead, cadmium, cobalt, and nickel concentrations were below the limits of detection for the analytical scheme used. The concentrations of particulate iron and copper and total 'soluble' nickel varied as a function of tide and sample locations. Most of the iron was in the particulate form. (NOAA)  
W79-05117

**GROUND-WATER POLLUTION-A LIMITED PROBLEM.**  
Dunn Geoscience Corp., Latham, NY.  
For primary bibliographic entry see Field 5B.  
W79-05122

**GROUND-WATER QUALITY STANDARDS-A NEUTRAL VIEW.**  
Michigan Dept. of Public Health, Lansing.  
For primary bibliographic entry see Field 5B.  
W79-05123

**DIP BASKET FOR COLLECTING JUVENILE SALMON AND TROUT IN GATEWELLS AT HYDROELECTRIC DAMS.**  
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.  
G. A. Swan, R. F. Krcma, and W. E. Farr.  
The Progressive Fish Culturist, Vol. 41 No. 1, p. 48-49, 1979. 3 fig, 2 ref.

Descriptors: \*Columbia River, \*Snake River, \*Little Goose Dam, Fishing gear, \*Dams, Dam operations, \*Gateways, Juvenile fish, Salmon, Trout, Hydroelectric dams, Methodology, Fish migration, Fish conservation, Fish handling facilities, Fish guiding, Dip basket.

The design and operation of a dip basket for collecting fingerling salmon from modified gateways at Little Goose Dam in the Snake River is described. 400 to 500 fingerlings could be accommodated in the bag. (Katz-EIS)  
W79-05175

**HATCHING TABLE FOR FISHERIES RESEARCH.**  
Washington Univ., Seattle. Coll. of Fisheries.  
P. L. Hickey, W. K. Hershberger, and J. N. Dong.  
The Progressive Fish Culturist, Vol. 41 No. 1, p. 25-26, 1979. 1 fig, 2 ref.

Descriptors: \*Methodology, \*Water quality, Water pollution effects, Laboratory tests, \*Laboratory equipment, Fish hatcheries, \*Fish eggs, Mortalities, Chinook salmon, Hatching table, Fish physiology.

An incubation system is described that permits the incubation of many separate groups of eggs with an equivalent water quality conditions. Containers are removable for ease of handling and data collection. (Katz-EIS)  
W79-05178

**RAPID VACUUM METHOD FOR REMOVAL OF MUCUS FROM THE EPIDERMIS OF FISHES.**  
Louisville Univ., KY. Dept. of Biology.  
T. R. Kozel, and K. W. Dobra.  
The Progressive Fish Culturist, Vol. 41, No. 1, p. 18-19, 1979. 8 ref.

Descriptors: \*Methodology, \*Toxicity, \*Freshwater fish, Laboratory equipment, Laboratory tests, \*Water pollution effects, Chemical analysis, Fish physiology, Epidermis, Mucus, \*Mucus removal, Fish epidermis.

A method is described of removing mucus from the epidermis of fish by a mild vacuum system. The mucus is available for microscopic examination. The procedure is useful for getting material for chemical and biological measurement. (Katz-EIS)  
W79-05180

## Identification Of Pollutants—Group 5A

**SELF-CONTAINED UPWELLING SYSTEM FOR REARING LARVAL FISHES IN THE LABORATORY**

Florida State Game and Freshwater Fish Commission, Boca Raton.  
P. L. Shafland.

The Progressive Fish Culturist, Vol. 41, No. 1, p 10-13, 1979. 3 fig, 98 ref.

Descriptors: \*Aquaculture, \*Methodology, \*Laboratory equipment, \*Salinity, Sea water, \*Juvenile fish, Mortality, Fish conservation, Fish establishment, Fish hatcheries, Laboratory tests, Fish reproduction, Juvenile growth stage, Snook, Centropomus, Aquaria.

The design and operation of a rearing and salinity conversion system is described. This system was developed and successfully used to rear snook from artificially fertilized eggs for the first time. Each chamber is individually plumbed to produce an upwelling current by introducing water at the bottom and discharging it near the top. Snook were reared through the early larval stages in salt water and then converted to fresh water. Use of this system enabled the evaluation of the foods, feeding behavior, and growth of larval snook under laboratory conditions; and investigations of the freshwater tolerance of young snook. (Katz-EIS)

W79-05182

**MODIFICATIONS OF TEMPERATURE AVOIDANCE TROUGHS FOR TESTING SMALL FISHES**

Maryland Univ., Frostburg, Appalachian Environmental Lab.  
E. L. Melisky, J. R. Stauffer, D. A. Cincotta, and C. H. Hocutt.

The Progressive Fish Culturist, Vol. 41, No. 1, p 44-45, 1979. 4 fig, 10 ref.

Descriptors: \*Laboratory tests, \*Bioassays, \*Methodology, \*Water temperature, Criteria, Laboratory equipment, Temperature Avoidance, Troughs, Aquatic environment, Thermal additions, Freshwater fish.

A temperature avoidance trough for small fishes is described. It is used to establish temperature criteria required to protect ecosystems against thermal additions to the aquatic environment. The design eliminated turbulence present in other models. (Katz-EIS)

W79-05185

**EARLY SAMPLES OF OIL IN WATER AND SOME ANALYSES OF ZOOPLANKTON**

Torrey Research Station, Aberdeen (Scotland).  
P. R. Mackie, R. Hardy, E. I. Butler, P. M. Halligan, and M. F. Spooner.

Marine Pollution Bulletin, Vol. 9, No. 11, p 296-297, 1978. 2 tab, 5 ref.

Descriptors: \*Oil, \*Oil spills, \*Water pollution effects, \*Amoco Cadiz, Water analysis, On-site investigation, Petroleum hydrocarbons, \*Zooplankton, Copepoda, Tissue fluorescence, Crude oil, Aromatic hydrocarbons, n-alkanes, Path of pollutants.

A cruise by the oceanographic vessel Sarsia was made to sample the waters in the areas polluted by the Amoco Cadiz spill. Analyses were made of the n-alkanes and the aromatics. Zooplankton taken by the Sarsia were analyzed for their aromatic content. Fluorescence in tissue of copepods showed some correlation with the expected degree of pollution. (Katz-EIS)

W79-05186

**EDITORIAL INTRODUCTION**

Marine Biological Association of the United Kingdom, Plymouth (England). Plymouth Lab.

M. F. Spooner.  
Marine Pollution Bulletin, Vol. 9, No. 11, p 281-284, 1978. 1 tab, 1 fig.

Descriptors: \*Oil, \*Oil spills, \*Amoco Cadiz, Brittany, Light Arabian crude, Light Iranian crude, \*Water pollution effects, \*Detergents, Dispersants, Currents (Ocean), Mousse, Oil slicks, Toxicity, Plankton, Benthos, \*Benthic fauna, Clean up, Costs, Tourism, Commercial fisheries.

The Nov 1978 issue of the Marine Pollution Bulletin is devoted entirely to the Amoco Cadiz oil spill. The supertanker was wrecked on 16 March, 1978, off Portail, Brittany, with the loss of the entire cargo. Brief contributions have been widely invited from those engaged in research on the effects of this, the most serious spill in the history of oil pollution. A general introductory account has been given by Dr. L. Laubier, Directeur du Centre Oceanologique de Bretagne, who summarized in June points of special interest (including fisheries aspects). Fuller reports are to be found elsewhere (listed at the end of this issue). It is inevitable that some important aspects have not been covered in the papers received and these subjects are briefly mentioned here. (Katz-EIS)

W79-05188

**THE AMOCO CADIZ OIL SPILL-LINES OF STUDY AND EARLY OBSERVATIONS**

Centre Oceanologique de Bretagne Brest (France).  
L. Laubier.

Marine Pollution Bulletin, Vol. 9, No. 11, p 285-287, 1978.

Descriptors: \*Oil, \*Oil spills, \*Amoco Cadiz, \*Water pollution effects, \*Monitoring, Chemical analysis, \*Environmental effects, Chemical analysis, Water quality, Sediments, Zooplankton, Benthos, Benthic animals, On-site investigations, Petroleum, Hydrocarbons, Toxicity, Mortality, Bay of Morlaix, Brittany, Sea birds, Fate of oil, Benthic plants.

Following the Amoco Cadiz oil spill a research program was conducted by several French organizations, United States governmental, university and private organizations, by the Canadian Bedford Institute of Oceanography and by the Marine Biological Association of the United Kingdom. The program consists of monitoring the chemical quality of the water, the sediments, the marine organisms, studies of the ecological effects, microbiological processes and toxicological research. (Katz-EIS)

W79-05189

**PETROLEUM HYDROCARBON ANALYSES CONDUCTED FOLLOWING THE WRECK OF THE SUPERTANKER AMOCO CADIZ**

Ministry of Agriculture, Fisheries and Food, Burnham-on-Crouch (England). Fisheries Lab.

R. J. Law.  
Marine Pollution Bulletin, Vol. 9, No. 11, p 293-296, 1978. 5 tab, 2 fig, 7 ref.

Descriptors: \*Oil, \*Oil spills, \*Water pollution effects, \*Amoco Cadiz, Brittany, English Channel, On-site investigations, Sediment, \*Chemical analysis, Sea-Water, Sampling, Methodology, Monitoring, Gas chromatography, Biodegradation, Weathered oil, \*Petroleum hydrocarbons.

Following the wreck of the Amoco Cadiz on 16 March 1978, samples of water, sediment and oil were collected between April and June from the Brittany coast and western English Channel and were analysed for petroleum hydrocarbons by means of fluorescence spectroscopy, gas-liquid chromatography and gas chromatography-mass spectrometry. (Katz-EIS)

W79-05196

**ENVIRONMENTAL PATHWAYS OF SELECTED CHEMICALS IN FRESHWATER SYSTEMS PART II: LABORATORY STUDIES**

SRI International Menlo Park, CA.  
J. H. Smith, W. R. Mabeu, N. Bohonos, B. R. Holt, and S. S. Lee.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-288 511, Price codes: A19 in paper copy, A01 in microfiche.

Environmental Protection Agency, Report EPA-600/7-78-074, 432 p, May 1978. 93 fig, 165 tab, 235 ref.

Descriptors: \*Fossil fuels, \*Pesticide residues, \*Pollutant identification, Chemical properties, Physicochemical properties, Chemical analysis, Pesticides, Organic compounds, Path of pollutants, Biodegradation, Persistence, Eutrophication, Trophic level, Oligotrophy, Microbial degradation, Chemical degradation, Absorption, \*Methyl parathion, \*Mirex, \*Photolysis, Benzo(a)pyrene.

Environmental exposure assessment models and laboratory procedures for predicting the pathways of potentially harmful chemicals in freshwater environments were described in Part I of this report (EPA-600/7-77-113). Procedures were developed for measuring the rates of volatilization, photolysis, oxidation, hydrolysis, and biotransformations as well as the sorption partition coefficients on natural sediments and on a mixture of four bacteria. The results were integrated with a simple computer model to predict the pathways of chemicals in ponds, rivers, and lakes. This second part of the project report describes the successful application of these procedures to 11 chemicals of environmental interest. The chemicals were p-cresol, benz(a)anthracene, benzo(a)pyrene, quinoline, benzo(f)quinoline, 9H-carbazole, 7H-dibenz(c,g)carbazole, benzo(b)thiophene, and dibenzothiophene, which might be found in the effluents of plants using or processing fossil fuels, and methyl parathion and mirex, which are agricultural pesticides. (Deal-EIS)

W79-05198

**MULTIPLE BOTTLE HOLDER FOR IN SITU MEASUREMENT OF PRIMARY PRODUCTIVITY**

Battelle Pacific Northwest Lab., Richland, WA.  
D. A. Neitzel, T. L. Page, and E. G. Wolf.

The Progressive Fish Culturist, Vol. 41, No. 1, p 42-43, 1979. 1 fig, 4 ref.

Descriptors: \*Methodology, \*Laboratory apparatus, On-site investigation, \*Primary productivity, \*Biochemical oxygen demand, Columbia River, Multiple bottle holder, In-situ measurements.

An apparatus is described for the in situ incubation of samples for primary productivity measurements at various depths. BOD samples have been incubated in the Columbia River at depths from 0.5 m to 0.6 m, in currents up to 3.0 meters per second. (Katz-EIS)

W79-05201

**ANNOUNCEMENT OF COMPOUNDS REGISTERED FOR FISHERY USES**

National Fishery Research Lab., LaCrosse, WI.  
R. A. Schnick, and F. P. Meyer.

The Progressive Fish Culturist, Vol. 41, No. 1, p 36-37, 1979. 1 tab.

Descriptors: \*Fish diseases, \*Fish culture, \*Aquaculture, Herbicide, Algicide, Lampricide, \*Fish toxicant, Food fish, Pond sterilant, Anesthetic, Oxidizer, Detoxifier, Prophylactic, Parasiticide, Registration, Compounds for fishery use.

A special report on compounds approved for fishery use has been released by the Fish & Wildlife Service. The report is a summary of the chemicals for which fishery uses have been registered or exempted from registration and of four compounds for which the status is still indefinite. (Katz-EIS)

W79-05205

**CONCENTRATIONS OF SELECTED ELEMENTS AND ASH IN BLUEGILL (LEPOMIS MACROCHIRUS) AND CERTAIN OTHER FRESHWATER FISH**

Breedlove Associates, Inc., Gainesville, FL.  
J. A. Davis, and C. E. Boyd.

Transactions of the American Fisheries Society, Vol. 107, No. 6, p 862-867, 1978, 2 fig, 4 tab, 26 ref.



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

Descriptors: \*Sunfishes, \*Calcium, \*Magnesium, \*Potassium, \*Sodium, Nitrogen, Phosphorus, \*Sulfur, Fly ash, Chemical analysis, Fish physiology, Animal metabolism, Fish populations, Freshwater fish, Electro-fishing, Water chemistry, Industrial wastes, Chemical wastes, \*Tissue analysis, \*Ash.

Studies on the elemental composition of bluegills and other freshwater fish revealed that fish differ in concentrations of calcium, magnesium, potassium, sodium, nitrogen, phosphorus, sulfur, and ash depending upon species, size, and collecting site. For rigorous considerations of the elemental composition of fish in a body of water, fish of different species and sizes must be collected and analyzed. Nevertheless, for many ecological purposes the variation in elemental concentrations was not too large to prevent generalizations from data presented in this study. (Deal-EIS)  
W79-05208

**A MERCURY BUFFER FOR TOXICITY EXPERIMENTS WITH GREEN ALGAE,**  
Technische Hogeschool, Delft (Netherlands). Lab. of General and Technical Biology.  
J. Huisman, and H. J. G. Ten Hoopen.  
Water, Air and Soil Pollution, Vol. 10, No. 3, p 325-334, 1978, 4 fig, 4 tab, 6 ref.

Descriptors: Heavy metals, Chlorides, Chlorophyta, Chemical reactions, Reduction (Chemical), Evaporation, Growth rates, Chemical analysis, Chemical properties, \*Buffers, \*Mercury compounds, \*MIDA, \*Mercury, \*Scenedesmus, \*Toxicity.

Mercury (II) toxicity experiments with green algae are complicated by the fast reduction and evaporation of Hg. A Hg buffer system is described, which considerably stabilizes the Hg(II) concentration in test solutions. The Hg buffer consists of mercury(II) chloride and N-methyliminodiacetic acid(MIDA). Dissociation of Hg-MIDA complex compensates for loss of Hg. With this system experiments were performed with Hg(II) concentrations between 0.02 and 2.0 mg l<sup>-1</sup> at temperatures between 15 and 30°C. No effect of MIDA on the growth of the green alga *Scenedesmus acutus* was detected. (Deal-EIS)  
W79-05210

**MODIFIED NEUSTON NET FOR COLLECTING LIVE LARVAL AND JUVENILE FISH,**  
National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.  
W. F. Hettler.  
The Progressive Fish Culturist, Vol. 41, No. 1, p 32-33, 1979, 1 fig, 3 ref.

Descriptors: \*Laboratory equipment, \*Larval fish, \*Juvenile stages, \*Zooplankton, Fishing, Fishing gear, Fish collections, Methodology, Neuston sampler, Monitoring, \*Sampling.

A neuston net has been used successfully at the Beaufort Laboratory to catch larval and juvenile fish for physiological and toxicological experiments. The collector has not been evaluated for net-induced mortality of captured organisms nor for its efficiency. Only few larval fish are impinged on the mesh. (Katz-EIS)  
W79-05211

**DEVELOPMENT OF A RAPID TISSUE BIOASSAY TECHNIQUE FOR SCREENING POLLUTANT EFFECTS ON FISH,**  
Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.  
A. A. Friedman, and C. B. Coburn.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 469, Price codes: A10 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center, University of Tennessee, Knoxville, Research Report No. 71, March 1979, 199 p, 37 fig, 5 tab, 39 ref, append. OWRT A-034-TENN(3), 14-34-0001-7090.

Descriptors: \*Bioassay, Toxicity limits, \*Pesticide toxicity, Liver, Fish physiology.

A rapid and relatively inexpensive tissue respirometric method for assessing the toxic effect of some classes of pollutants on fish has been developed and tested. It appears that fish liver homogenate respirometry is comparable with conventional fish bioassay with systemic toxicants other than those which primarily interfere with gas transfer mechanisms in the gill or are neurotoxicants. The response patterns of liver respirometry were similar in different species of fish and at different temperatures. Liver homogenates frozen in Krebs-Ringer's phosphate had a viability over six months when stored at -20°C.  
W79-05229

**URBAN RAINFALL-RUNOFF-QUALITY DATA BASE,**  
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.  
For primary bibliographic entry see Field 2A.  
W79-05282

**SYSTEMS FOR RAPID RANKING OF ENVIRONMENTAL POLLUTANTS. SELECTION OF SUBJECTS FOR SCIENTIFIC AND TECHNICAL ASSESSMENT REPORTS,**  
SRI International, Menlo Park, CA.  
S. L. Brown, B. R. Holt, and K. E. McCaleb.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-284 338, Price codes: A13 in paper copy, A01 in microfiche. EPA-600/5-78-012, Office of Health and Ecological Effects, Office of Research and Development, U.S. Environmental Protection Agency, Washington, DC., June 1978, 295 p, 2 fig, 17 tab, 84 ref, 9 appen.

Descriptors: \*Environmental control, \*Ranking, \*Pollutants, Air pollution, Water quality, Contaminants, Assessment, Systems analysis, Ecology, Criteria, STAR, Priorities, Hazards, Cobalt, Carbon disulfide, Lithium, Beryllium, Plutonium, Heat, Cyanides, Carbonyl sulfide, Antimony, Molybdenum.

This document reports the results of the development and testing of a system for rapidly ranking environmental pollutants. One potential use for the system is in choosing the most important candidates for Scientific and Technical Assessment Reports (STAR). Of several possible approaches to ranking environmental agents, a system depending on expert opinion but assisted by an objective subsystem was selected for development. The system defines procedures for collecting, processing, and evaluating data on production and use; environmental transport, transformation, and rate; and human health and welfare and ecological effects. A test of the objective subsystem confirmed the utility of the system. Of ten candidate agents, the three highest ranked were cyanides, carbon disulfide, and beryllium. (Bell Graf-Cornell)  
W79-05286

**CONTROL OF OIL POLLUTION BY REMOTE SENSING ALONG THE SHORES OF FRANCE,**  
French Embassy, Washington, DC.  
For primary bibliographic entry see Field 7B.  
W79-05392

**REMOTE SENSING FOR OIL POLLUTION CONTROL ALONG COASTAL WATERS OF THE UNITED STATES,**  
Coast Guard Research and Development Center, Groton, CT.  
For primary bibliographic entry see Field 7B.  
W79-05393

**DETERMINATION OF CHLORIDE IN SULFITE PULP MILL EFFLUENTS (CHLORID-BESTIMMUNG IN SULFITZELLSTOFF-ABLAUGEN),**  
W. Kunstner, J. Hupfl, and S. Pfeiffer.  
Das Papier, Vol. 32, No. 10, p 441-445, October,

1978, 3 illus, 3 ref, 2 tab. English summary.

Descriptors: \*Sulfite liquors, \*Chlorides, \*Waste identification, Water analysis, Fuels, Pulp wastes, Wastes, Industrial wastes, Water pollution sources, Pulp and paper industry, Effluents, Organic compounds, Ion exchange, Incineration, Oxygen, Volumetric analysis, Photometry, Analytical techniques, Pollutant identification.

Existing methods of chloride determination in sulfite pulp mill effluents or in fuels were refined to improve their accuracy. First, organic substances in the effluent must be removed, either by ion-exchange or by incineration in a stream of oxygen. Electrometric titration can follow in either case, but a photometric method using mercury thiocyanate may be substituted following the incineration procedure. Because of the very low chloride content and the high organic content of the effluents, deviations of 3-20%, depending on chloride content, must be expected. (Ward-IPC)  
W79-05432

**MEASUREMENT OF DISSOLVED OXYGEN,**  
RCA Lab. Ltd., Zurich (Switzerland).  
M. L. Hitchman.  
John Wiley and Sons, New York, N.Y. 1978, 235 p.

Descriptors: \*Water analysis, \*Dissolved oxygen, Analytical techniques, Polarographic analysis, Electrochemistry, Colorimetry, Manometers, Mass spectrometry, Thermodynamics, Gas chromatography, Oxygen, Solubility, Chemical analysis.

The eight chapters of this monograph discuss the need and importance of dissolved oxygen measurements, thermodynamic aspects, principles of voltammetry, membrane-covered polarographic detectors, electrochemical and chemical methods of dissolved oxygen determinations, including the Winkler method and its modifications, colorimetry, radiometry, and gas-phase measurements via manometry, volumetry, mass spectrometry, thermooxidation, paramagnetism, and gas chromatography. Oxygen solubility tables, electrode potentials, convective flow and diffusion, and other useful appendices are included, along with a list of symbols used and a subject index. (Brown-IPC)  
W79-05434

**SOLUBLE ORGANIC CONSTITUENTS OF NATURAL WATERS AND WASTEWATERS BEFORE AND AFTER CHLORINATION,**  
North Texas State Univ., Denton. Inst. of Applied Sciences; and North Texas State Univ., Denton. Dept. of Chemistry.

W. H. Glaze, and G. R. Peyton.  
In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H. and Hamilton, D.H. Jr., (Eds). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 3-14, 1978 4 fig, 15 ref.

Descriptors: \*Water pollution, \*Chlorination, \*Waste water treatment, Organic compounds, Analytical techniques.

The purpose of this paper was to report preliminary results which support the existence of intermediate molecular weight chlorine compounds in treated wastewater effluents and to present some details of an approach to the characterization of these species. The molecular weight profile of the water organics before and after chlorination was compared. Chlorination of a municipal treatment plant effluent with a high concentration of chlorine resulted in a peak representing a decrease in molecular weight of almost exactly one-half and a shoulder corresponding to molecules which are half the size of those comprising the main peak, showing that the addition of enough chlorine to produce a large residual results in the breakage of only a few bonds in the macromolecular backbone. Comparison of results using raw water with those from wastewater studies revealed that major components are found in raw water at the same molecular size as in wastewater. (See also W79-05435) (Chilton-ORNL)



## Identification Of Pollutants—Group 5A

W79-05436

**PRECURSORS AND MECHANISMS OF HALOFORM FORMATION IN THE CHLORINATION OF WATER SUPPLIES.**

Harvard Univ., Cambridge, MA. Div. of Applied Sciences.

J. C. Morris, and B. Baum.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D.H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 29-48, 1978 12 fig, 4 tab, 8 ref. EPA R603231-02.

Descriptors: \*Chlorination, \*Water chemistry, Organic compounds, Water pollution, Public health, Freshwater, Chloroform, Environmental effects.

Representatives of pyrrole-type compounds and of acetogenins were selected for study as potential precursors for formation of chloroform in water chlorination. Chlorine demand and chloroform yield were investigated as a function of time at varied pH values and different ratios of aqueous chlorine to organic compound. Results indicated two broad conclusions of general interest. First, a variety of organic substances likely to be present in natural waters may contribute to chloroform formation by way of the haloform reaction. Fulvates and humates are important precursors but not the only ones. Second, attention should be given to the total number of chlorine-carbon bonds produced and not only to chloroform produced. It was suggested that maintenance of hygienic quality of water with regard to hazards from chlorinated organic compounds will be best achieved by control of the total organic chlorine. (See also W79-05435) (Chilton-ORNL)

W79-05438

**REACTIONS OF CHLORINE, CHLORINE DIOXIDE AND MIXTURES THEREOF WITH HUMIC ACID: AN INTERIM REPORT.**

Olin Corp., New Haven, CT. Research and Development Center.

M. G. Noack, and R. L. Doerr.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 49-58, 1978. 6 fig, 2 tab, 11 ref.

Descriptors: \*Chlorination, \*Water chemistry, Water treatment, Chlorine, Disinfectants, Oxidation, Potable water, Environmental effects.

This paper presents an interim report on research to define the chemistry of disinfecting drinking water with chlorine, chlorine dioxide and mixtures thereof in the presence of model humic acid. Investigations of kinetics and oxidant demand which plotted chlorine concentration vs. time in distilled water containing humic acid indicated the existence of no less than two simultaneous reactions distinguishable on the basis of overall order and rate. A fast chlorine demand was observed which increased with pH and the rate of the second-order reaction decreased. Ratios of fast  $\text{ClO}_2$ /fast  $\text{Cl}_2$  demand at comparable pH values were roughly equal to the ratio of equivalent weights of  $\text{ClO}_2/\text{Cl}_2$ . In studies of formation of  $\text{CHCl}_3$  in reaction with  $\text{Cl}_2$ , data suggested the existence of an intermediate product before the appearance of  $\text{CHCl}_3$ . No significant pH effect was found on the formation of chlorite ion through reduction of  $\text{ClO}_2$ . Study of the effect of mixtures of  $\text{Cl}_2$  and  $\text{ClO}_2$  showed that at pH 6.0 to 7.0 the chlorite ion was oxidized by chlorine to chlorate. It was concluded that at pH 6.0 to 7.0 a 1:1 mixture of chlorine and chlorine dioxide might be an alternative to water treatment with chlorine or chlorine alone. (See also W79-05435) (Chilton-ORNL)

W79-05439

**AQUEOUS CHLORINATION PRODUCTS OF POLYNUCLEAR AROMATIC HYDROCARBONS.**

Minnesota Univ., Duluth. Dept. of Chemistry.

R. M. Carlson, R. Caple, A. R. Oyler, K. J. Welch, and D. L. Bodenmer.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H. and Hamilton, D.H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 59-65, 1978 1 fig, 1 tab, 14 ref. EPA R 803952.

Descriptors: \*Chlorination, \*Water chemistry, PAH, Potable water, Hydrogen ion concentration, Oxidation.

The purpose of this research was to identify the reaction products of the aqueous chlorination of selected polynuclear aromatic hydrocarbons (PAHs) including some found in drinking water. Reactions were conducted under varying conditions of time, chlorine dosage and pH as might be encountered during actual treatment. Experimental results showed that extent of conversion of PAHs to secondary products was related to pH with greater acidity resulting in greater conversion. With the exception of formation of anthraquinone upon chlorination of anthracene, the oxidation products whose structures were determined had chlorine incorporated into the aromatic nucleus. During analysis of chlorination products of fluoranthene, the initial reverse-phase HPLC separation indicated a polar derivative but subsequent GC/MS analysis indicated a more lipophilic monochlorosubstitution product. The initial formation of a chlorohydrin is suggested as explanation of these conflicting observations. (See also W79-05435) (Chilton-ORNL)

W79-05440

**REACTIONS IN CHLORINATED SEAWATER.**

Rosenstiel School of Marine and Atmospheric Science, Miami, FL.

J. H. Carpenter, and C. A. Smith.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H. and Hamilton, D.H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 195-207, 1978 7 fig, 15 ref. EPA R803893 & ERDA AT (40-1)-3801.

Descriptors: \*Chlorination, \*Water chemistry, Organic compounds, Sea water, Halogens, Copper, Toxicity, Environmental effects, Water pollution.

This paper discusses the chemistry of chlorinated sea water in terms of residual oxidants, bromate formation, formation of halogenated organic compounds and the modification of copper complexing capacity. Techniques for the analysis of residual oxidants in chlorinated sea water are presented. Sunlight exposure of chlorinated sea water produced substantial conversion of the oxidative capacity in added chlorine to bromate ion. Significance of this bromate formation in producing direct toxicity or the slow formation of halogenated organic compounds is uncertain. Bromoform and, to a lesser extent, chlorodibromomethane are identified as the most obvious organic products of chlorination of sea water. Reactions are oxidant-limited. At 1 and 2 ppm chlorine addition levels, the residual oxidants drop rapidly with a corresponding increase in bromoform. Calculations show that bromoform formation is not a first-order reaction. Experimental results indicated that chlorine addition has the potential for modifying the organic compounds that nearly completely complex copper in natural waters and increase the toxicity of the copper presence. (See also W79-05435) (Chilton-ORNL)

W79-05450

**CHLORINE DEGRADATION AND HALOCARBON PRODUCTION IN ESTUARINE WATERS.**

Maryland Univ., College Park. Dept. of Chemistry.

G. R. Helz, R. Sugam, and R. Y. Hsu.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H. and Hamilton, D.H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 209-222, 1978. 4 fig, 2 tab, 14 ref. EPA R 803839-01/02.

Descriptors: \*Chlorination, \*Water pollution, \*Water chemistry, Sea water, Estuaries, Discharge(Water), Chlorine, Cooling water, Chemical degradation.

This paper deals with the chemical processes which create chlorine demand and control chlorine decay in estuarine waters. Field observations show that 90% of oxidant dose disappears by the time cooling water emerges from the plant. This large oxidant loss observed in the discharge canal was not seen under laboratory conditions. A slow decay phase was seen to follow the fast decay phase with the slow decay rate being slightly faster in daytime than nighttime. No free chlorine was ever detected in the canal. Only traces of haloforms were found in discharge waters. Ammonia nitrogen increased from intake canal to terminus of discharge canal. Chlorine decay processes are discussed in some detail and attempts are made to provide interpretation of the indicated field observations. (See also W79-05435) (Chilton-ORNL)

W79-05451

**INVESTIGATION OF HALOGENATED COMPONENTS FORMED FROM CHLORINATION OF MARINE WATER.**

Batelle Pacific Northwest Lab., Richland, WA. R. M. Bean, R. G. Riley, and P. W. Ryan.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H. and Hamilton, D.H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 223-233, 1978. 2 fig, 2 tab, 8 ref.

Descriptors: \*Chlorination, \*Water chemistry, Water pollution, Halogens, Analytical techniques, Sea water.

This paper reports a study which investigates the formation of nonpolar, presumably lipophilic organohalogen in sea water. Gas chromatographic analysis techniques are discussed. Analysis of extracts obtained from the forcing of sea water through XAD-2 resin columns showed the principal component in all sea water samples to be bromoform. Smaller quantities of dibromochloromethane and traces of dichlorobromomethane were found. Chloroform was not present in significant concentration. On the basis of results obtained so far, it was concluded that concentrations of nonpolar and presumably lipophilic components generated by low-level chlorination of relatively pristine sea water are low. (See also W79-05435) (Chilton-ORNL)

W79-05452

**THE EFFECT OF AMMONIA CONCENTRATION ON THE CHEMISTRY OF CHLORINATED SEA WATER.**

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.

G. W. Inman, Jr., and J. D. Johnson.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H. and Hamilton, D.H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 235-252, 1978. 8 fig, 1 tab, 19 ref. NRC-04-77-119.

Descriptors: \*Chlorination, \*Water chemistry, Water pollution, Sea water, Ammonia, Nitrogen, Bromides.

The primary purpose was to determine the critical ammonia-to-bromide ratio where monochloramine formation begins to predominate over bromamine formation. Experimental results showed that a mixture of dibromamine and monochloramine will form in full-strength chlorinated sea water when the ammonia nitrogen is greater than 0.5 mg/l and the chlorine dose is less than 2.5 mg/l. At higher ammonia concentration and longer times, monochloramine becomes the major component of the total oxidant concentration. The critical weight ratio of ammonia nitrogen: bromide was found to be approximately 0.008 at pH 8.1. At higher ratios, monochloramine predominates after 30 minutes to 1 hour and, at lower ratios, the oxidant concentration consists of dibromamine with a small fraction

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

of the total oxidant being monochloramine. (See also W79-05435) (Chilton-ORNL)  
W79-05453

#### MICROBIAL DEGRADATION OF HALOGENATED HYDROCARBONS,

Texas Univ. at Austin. Dept. of Microbiology. A. W. Bourquin, and D. T. Gibson.  
In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 253-264, 1978. 3 fig, 3 tab, 21 ref. EPA R 804525.

Descriptors: \*Chlorination, \*Water chemistry, Water pollution, Halogens, Sea water, Microbial degradation.

Biochemical and soil microbiology studies reported in this paper indicate that numerous mechanism exist for the dehalogenation of both aliphatic and aromatic hydrocarbons. The existence of enzymatic systems capable of dehalogenation is shown. It is pointed out that the existence of organisms in the marine environment capable of such biodegradation is as yet undetermined but it seems feasible to assume that the same type reactions could occur in the marine environment as in the terrestrial environment. (See also W79-05435) (Chilton-ORNL)  
W79-05454

#### OPTIMIZING TRIHALOMETHANE ANALYSIS,

Montgomery (James M.) Inc., Pasadena, CA. Environmental Research Lab.  
A. R. Trussell, M. D. Umphres, L. Y. C. Leong, and R. R. Trussell.  
In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 543-553. 1978. 1 fig, 4 tab, 13 ref.

Descriptors: \*Water chemistry, \*Analytical techniques, Chlorination, Water quality.

This study reports on liquid-liquid extraction (LLE) technique for the analysis of trihalomethanes. The technique is approached systematically to overcome difficulties associated with the method in the past. Quality assurance is enhanced by the high resolution of glass capillary gas chromatography. It is suggested that further research is needed to further define the best conditions for sample preservation, extraction and specific detection. It was concluded that the proven success and simplicity of LLE make it the most promising routine analytical technique at the present time. (See also W79-05435) (Chilton-ORNL)  
W79-05476

#### MEASUREMENT AND SIGNIFICANCE OF SPECIFIC ACTIVITY IN THE HETEROTROPHIC BACTERIA OF NATURAL WATERS,

Gordon Coll., Wenham, MA. Dept. of Biology. R. T. Wright.  
Applied and Environmental Microbiology, Vol. 36, No. 2, August 1978, p 297-305. 6 fig, 3 tab, 31 ref. NSF DES 73-6650 & OCE 77-19446.

Descriptors: \*Bacteria, \*Heterotrophy, \*Specific activity, \*Measurement, \*Counting, \*Methodology, \*Analytical techniques, \*Estuarine environments, Staining, Acridine orange direct count, Epifluorescence, Radioisotopes, Massachusetts, Estuaries, Coasts, Atlantic Ocean, Oceans, Degradation(Decomposition), Metabolism, Physiology, Specific activity indices, Tracers, Indicators, Filters, Habitats, Nutrients.

A 'specific activity index' which expresses the relationship between heterotrophic bacterial activity and the bacteria responsible for that activity, combines accurate total counts of bacteria (using the acridine orange direct count (AODC) and epifluorescence microscopy) and three highly sensitive measures of heterotrophic activity using radio-

isotopes. The three indices—(1) V sub max kinetic approach, (2) turnover rate-tracer approach, and (3) direct uptake measurement approach—all utilize direct bacterial count as the denominator, but have different numerators, each of which has been shown to vary directly with heterotrophic bacterial activity. The combined approach is illustrated with data from estuarine and coastal waters of northeastern Massachusetts, which show major differences in specific activity accompanying habitat differences, such as distance offshore or into an estuary, or vertical location in the water column. Data suggest that specific activity is a valid indicator of the physiological state and metabolic role of the bacteria. Some evidence shows that natural bacteria are adapted to conditions of nutrient starvation by becoming dormant, existing for an unknown period of time in a reversible physiological state reflecting organic nutrient availability. (Lynch-Wisconsin)  
W79-05490

#### A RAPID ESTIMATION OF 5-DAY BOD OF SPENT SULFITE LIQUOR,

Quebec Univ., Trois Rivières (Quebec). Pulp and Paper Research Center.  
J. J. Garceau, and S. N. Lo.  
Tappi, Vol. 61, No. 12, p 85-86, December 1978. 2 fig, 12 ref, 1 tab.

Descriptors: \*Sulfite liquors, \*Biochemical oxygen demand, Sulfite pulp mills, Wastes, Industrial wastes, Pulp wastes, Pulp and paper industry, Effluents, Water pollution sources, Carbohydrates, Analytical techniques, Water pollution control, Biological treatment, Glucose, Spent sulfite liquor, Water analysis.

Studies showed that the standard 5-day BOD of spent sulfite liquor (SSL) samples (200-15,000 mg/liter) correlates linearly with the total carbohydrate values, reported as apparent glucose (determined with an anthrone reagent). Based on a measured 5-day BOD of 6700 mg/liter and at 95% confidence, 5-day BOD can be predicted with the anthrone reagent within plus or minus 26% in 30 min. The total carbohydrate value is thus recommended for potential use to estimate 5-day BOD and to control the biological treatment of SSL. (Swichtenberg-IPC)  
W79-05500

### 5B. Sources Of Pollution

#### DEVELOPMENT AND EVALUATION OF A TWO-STEP MEMBRANE FILTER METHOD FOR FECAL COLIFORM RECOVERY IN CHLORINATED SEWAGE EFFLUENTS,

Illinois State Water Survey, Urbana.  
For primary bibliographic entry see Field 5A.  
W79-05012

#### THE SEYMOUR AQUIFER GROUND-WATER QUALITY AND AVAILABILITY IN HASKELL AND KNOX COUNTIES, TEXAS, VOLUME I.

Texas Dept. of Water Resources, Austin.  
For primary bibliographic entry see Field 2F.  
W79-05014

#### THE SEYMOUR AQUIFER GROUND-WATER QUALITY AND AVAILABILITY IN HASKELL AND KNOX COUNTIES, TEXAS, VOLUME II.

Texas Dept. of Water Resources, Austin.  
For primary bibliographic entry see Field 7C.  
W79-05015

#### A FINITE ELEMENT METHOD FOR THE DIFFUSION-CONVECTION EQUATION WITH CONSTANT COEFFICIENTS,

British Columbia Univ., Vancouver. Faculty of Graduate Studies.  
E. Varoglu, and W. D. L. Finn.  
Advances in Water Resources, Vol. 1, No. 6, p 337-343, December 1978. 10 fig, 1 tab, 20 ref.

Descriptors: \*Dispersion, \*Diffusion, \*Convection, \*Model studies, Mathematical models, Finite element analysis, Equations, Pollutants, Path of pollutants, Water pollution, Air pollution, Analytical techniques.

Existing numerical methods for the solution of the diffusion-convection equation are unsatisfactory for convection dominated flow problems. A new finite element method incorporating the method of characteristics for the solution of the diffusion-convection equation with constant coefficients in one spatial dimensions was derived. This method is capable of solving the diffusion-convection equation without any of the difficulties encountered in the existing numerical methods for the whole spectrum of dispersion from pure diffusion, through mixed dispersion, to pure convection. Several examples for the one-dimensional case were solved, and results were compared with the exact solutions. The generalization of the method to variable coefficients and to the diffusion-convection equation in two space dimensions was discussed. (Sims-ISWS)  
W79-05019

#### AN EVENT-BASED STOCHASTIC MODEL OF PHOSPHORUS LOADING INTO A LAKE,

Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering and Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.  
L. Duckstein, I. Bogardi, and M. Fogel.  
Advances in Water Resources, Vol. 1, No. 6, p 321-329, December 1978. 7 fig, 4 tab, 50 ref. NSF GF-38183.

Descriptors: \*Water pollution, \*Lakes, \*Phosphorus, \*Model studies, Mathematical models, Stochastic processes, Simulation analysis, Numerical analysis, Probability, Rainfall, Precipitation(Atmospheric), Runoff, Seasonal, Sediments, Watersheds(Basins), Pollutants, Path of pollutants, \*Lake Balaton(Hungary).

In most lakes, phosphorus (P) is the nutrient controlling the trophic state. Thus, for effective control of eutrophication, the uncertainty in P-loading should be encoded as a probability density function (pdf). Specifically, the pdf of P-loading Y from non-point agricultural sources was sought by means of an event-based stochastic model. P-loading events were triggered by precipitation events (X sub 1, X sub 2, T), in which X sub 1 was the rainfall amount, X sub 2 the duration, and T the interarrival time between events. (X sub 1, X sub 2) were dependent random variables, while T was assumed to be exponentially distributed. The precipitation event causes runoff, which carries dissolved P into the lake with a concentration C sub 1 and sediment yield, Z, which carries fixed or sorbed P into the lake in a fraction C sub 2 of Z. Seasonal loading of P was calculated by adding random numbers of random variables. The model accounted separately for dissolved P and sorbed P. Explicit expressions were given for the mean and variance of each type of P-loadings. The case study of a sub-watershed of Lake Balaton, Hungary, was used to illustrate the methodology. Precipitation data, empirical rainfall-runoff-sediment yield relationships, and a small number of observations of events were used to calibrate the model and to estimate the means and variances of loading per event and per season. Then, a simulation method was used to estimate complete pdf of these random variables. Use of the model for alternative methods of controlling P-loading was discussed briefly, as well as the economics of control. (Sims-ISWS)  
W79-05021

#### RADIAL DISPERSION TO AN ABSTRACTION WELL,

Birmingham Univ. (England). Dept. of Civil Engineering.  
For primary bibliographic entry see Field 2F.  
W79-05027



Sources Of Pollution—Group 5B

**FINITE-DIFFERENCE SOLUTIONS FOR ONE-DIMENSIONAL DISPERSION USING AN IMPROVED MESH DESIGN,**  
Birmingham Univ. (England). Dept. of Civil Engineering.

For primary bibliographic entry see Field 2F.  
W79-05028

**DRAINAGE DENSITY AT INDEX OF WATER-SHED DEVELOPMENT,**  
Rice Univ., Houston, TX. Dept. of Environmental Engineering.  
For primary bibliographic entry see Field 4A.  
W79-05034

**WASHOFF OF HERBICIDES APPLIED TO CORN RESIDUE,**  
Iowa State Univ., Ames. Dept. of Agricultural Engineering.  
D. C. Martin, J. L. Baker, D. C. Erbach, and H. P. Johnson.  
Transactions of the American Society of Agricultural Engineers, Vol. 21, No. 6, p 1164-1168, November-December 1978. 5 fig, 4 tab, 7 ref.

Descriptors: \*Herbicides, \*Runoff, \*Water pollution sources, Laboratory tests, Simulated rainfall, Pollutants, Path of pollutants, Corn, Crops, Weed control, Water pollution, Agriculture, \*Herbicide washoff, Corn residue.

In a laboratory study, herbicides, cyanazine, alachlor, atrazine, and propachlor were applied (0.4 and 1.8 kg/ha) to corn residue, which in turn was subjected to simulated rainfall. Concentrations and amounts of herbicides washing off with time were measured. Concentrations in initial washoff water were high for all herbicides (greater than 9 ppm for the high application rate). Concentrations decreased rapidly with time; approximately the same amount washed off with the first 0.5 cm of water as did with the next 3.0 cm of water. Mass balances of the applied herbicides showed that most of the herbicide washed off; little was retained by the corn residue with the exception of cyanazine. Unexplained losses of the other herbicides indicated the possibility of volatilization occurring between application of herbicides and application of washoff water about 12 h later. (Sims-ISWS)  
W79-05036

**SURFACE RUNOFF FROM SLUDGE-AMENDED SOILS,**  
Purdue Univ. Lafayette, IN. Dept. of Agronomy.  
E. J. Klavivko, and D. W. Nelson.  
Journal of the Water Pollution Control Federation, Vol. 51, No. 1, p 100-110, January 1979. 1 fig, 7 tab, 30 ref.

Descriptors: \*Sewage sludge, \*Sludge disposal, \*Surface runoff, Nutrients, Heavy metals, Water quality, Water pollution, Laboratory tests, Erosion, Sediments, Soils, Soil types, Loam, Nitrogen, Phosphorus, Carbon, Hydrogen ion concentration, Zinc, Copper, Lead, Nickel, Cadmium, Pollutants, Path of pollutants, Agriculture, Incorporation methods.

Liquid, anaerobically digested wastewater sludge was applied to a moderately well-drained silt loam soil at rates of 22.4, 56, and 89.6 metric tons per hectare and to a poorly drained silt loam and a well-drained sandy loam at a rate of 56 metric tons per hectare. After drying, the sludge was either incorporated into the soil by rototilling or disking or allowed to remain intact on the surface. Soil cores 0- to 15-cm deep were collected from the plots 2.5 months after sludge addition and subjected to a 5.72-cm/h rainstorm by a laboratory rainfall simulator. Runoff water and sediments were collected, weighed, and analyzed for phosphorus and nitrogen components; sediment, nutrient, and metal losses were assessed. (Sims-ISWS)  
W79-05041

**SYSTEMATIC DIURNAL CURVE ANALYSIS,**  
Hickok (Eugene A.) Associates, Wayzata, MN.  
J. B. Erdmann.

Journal of the Water Pollution Control Federation, Vol. 51, No. 1, p 78-86, January 1979. 8 fig, 1 tab, 16 ref, 1 append.

Descriptors: \*Water quality, \*Dissolved oxygen, \*Rivers, \*Model studies, Mathematical models, Diurnal, Variability, Respiration, Biochemical oxygen demand, Photosynthesis, Oxygen, Water pollution, Pollutants, Computer models, Simulation analysis, \*Charles River(MA).

Systematic diurnal curve analysis is an adaptation of the diurnal curve method for determining photosynthesis and respiration rates in rivers, based on dissolved oxygen measurements and hydraulic data. The new technique utilizes the Stokes total time derivative and, consequently, is valid even where time of flow between two stations exceeds one day. It is computerized; therefore, the technique can treat sets of dissolved oxygen measurements from many stations along a river taken over several days. The technique was applied to data from the Charles River in Massachusetts. Estimates of daily average photosynthesis and respiration ranged as high as 12.0 mg O<sub>2</sub> per litre and 36.2 mg O<sub>2</sub> per litre, respectively. The estimates were used to simulate average dissolved oxygen. The ratio of photosynthesis:respiration ranged from 0.32 to 0.96 in the down-stream direction. Photosynthesis was observed to be approximately double the magnitude of the diurnal dissolved oxygen range. Respiration exhibited a linear relationship with 5-day biochemical oxygen demand. (Sims-ISWS)  
W79-05042

**A GEOGRAPHICALLY VARIABLE WATER QUALITY INDEX USED IN OREGON,**  
Oregon State Dept. of Environmental Quality, Salem. Water Quality Div.  
D. A. Dunnette.

Journal of the Water Pollution Control Federation, Vol. 51, No. 1, p 53-61, January 1979. 7 fig, 4 tab, 23 ref.

Descriptors: \*Water quality, \*Streams, \*Rivers, \*Oregon, Sampling, Variability, Model studies, Mathematical models, Watersheds(Basins), Water pollution, Pollutants, Suspended solids, Dissolved solids, Turbidity, Heavy metals, Dissolved oxygen, Coliforms, Hydrogen ion concentration, Biochemical oxygen demand, Planning, \*Willamette River(OR), Water quality criteria, Indexes, Seasonal variations.

An Oregon Water Quality Index has been developed which takes into account differences in water quality resulting from geographical characteristics of separate basins. The index was developed for the purpose of providing a simple, concise, and valid method for expressing the significance of regularly generated laboratory data. The trend-monitoring value of the index was demonstrated for two quite different Willamette River stations. Correlations among this and several other proposed indexes averaged 0.87. Yearly and seasonal variations in water quality were quantized and found to average 88.9 and 78.9 Oregon Water Quality Index units for the higher and lower water quality stations, respectively, over the period 1971-1976. Calculated rates of change in water quality were +0.68 and +0.91 Oregon Water Quality Index units/year for the two stations for 1971-1976. The Oregon Water Quality Index is now used routinely in Oregon's primary station sampling program to recognize water quality trends. (Sims-ISWS)  
W79-05043

**FATE OF METAL IONS DURING DOMESTIC TREATMENT OF WATER CONTAINING ORGANICS,**  
New Hampshire Univ., Durham. Dept. of Chemistry.  
For primary bibliographic entry see Field 5F.  
W79-05046

**MOVEMENT OF PESTICIDES AND NUTRIENTS WITH WATER AND SEDIMENT AS AF-**

**FFECTED BY TILLAGE PRACTICES: A FIELD STUDY,**

Iowa State Univ., Ames. Dept. of Agricultural Engineering.  
J. L. Baker, and H. P. Johnson.  
Iowa State Water Resources Research Institute, Iowa State University, Completion Report, March 1978. 91 p, 4 fig, 7 tab, 3 append. OWRT A-050-1A(1), 14-31-001-5015.

Descriptors: \*Pesticide kinetics, \*Nutrients, \*Surface runoff, Herbicides, Insecticides, Soil erosion, Triazine pesticides, Pesticide movement, Nitrogen, Phosphorus, \*Tillage, Alachlor, Atrazine, Cyanazine, Fonofos, Ridge-plant, Till-plant.

Two conservation tillage systems were studied and compared with the conventional (plow-disk-plant) tillage system. Runoff, soil loss, nutrient losses, and pesticide losses during the 1972-75 growing seasons were measured for six small paired watersheds planted to continuous corn. The ridge-plant system had over 50% of the surface covered with residue, the till-plant system 11%, and conventional system less than 2%. Conservation tillage systems on the average reduced runoff about 40% and reduced soil loss 60 to 90%. Total losses of nitrogen and phosphorus (total P in sediment measured only in 1973) were mostly associated with soil loss and consequently were decreased for conservation tillage systems. Solution phosphorus losses and concentrations and available P concentrations in sediment (measured in 1974 and 1975) increased with residue cover. Fonofos, atrazine, alachlor, and cyanazine losses on the average were reduced by conservation tillage, although pesticide concentrations in sediment and/or water were sometimes higher. About one-half of the average fonofos losses were with water, whereas from 80 to 90% of the average herbicide losses were with water.  
W79-05050

**NONPOINT SOURCE POLLUTION FROM COASTAL PLAIN SOILS IN DELAWARE,**  
Delaware Univ., Newark. Dept. of Agricultural Engineering.

W. F. Ritter, R. P. Eastburn, and J. P. Jones.  
Paper No. 78-2046, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 26 p, 6 fig, 11 tab, 14 ref. ASAE, St. Joseph, Michigan.

Descriptors: \*Nutrient removal, Runoff, \*Surface runoff, Return flow, Pollutants, Agricultural watersheds, Rainfall, Delaware, \*Nonpoint pollution.

Nitrogen, phosphorus and organic matter were monitored on four agricultural watersheds in the Delaware Coastal Plain. Total nitrogen and total phosphorus loads in runoff and baseflow were less than the nitrogen and phosphorus loads in rainfall. (Skogerboe-Colorado State)  
W79-05065

**DETECTION OF ENTEROVIRUSES AND BACTERIAL PATHOGENS SURVIVING STANDARD SEWAGE TREATMENT,**  
Maryland Univ., College Park. Dept. of Microbiology.

F. M. Hetrick.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 209, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center, University of Maryland, Technical Report No. 53, January 1979. 35 p, 7 fig, 3 tab, 30 ref. OWRT A-035-MD(1) and A-036-MD(1). 14-34-0001-6021.

Descriptors: Ultrafiltration, \*Viruses, Sewage effluents, \*Pathogens, \*Coliforms, Shigella, Salmonella, Klebsiella, Proteus.

A commercially available dialysis unit, the Amicon DC-30 Diaflo unit, was evaluated for its utility in concentrating enteric viruses and bacteria from the effluents of a sewage treatment plant. The unit's efficiency for virus recovery was evaluated by seeding tap water samples with enteroviruses and then refining the concentration procedure so that acceptable virus recovery (>25%) was attained.



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

However, many difficulties were encountered when sewage effluents were examined, most notably the poor flow rates and the poor virus recovery. The particulate matter present in the effluent apparently adsorbs much of the virus that is present which is then removed with the suspended solids as the sample passes through the unit. The bacterial quality of the effluents was surprisingly good with coliform counts of some samples meeting recreational water standards, however, *Shigella*, *Salmonella*, *Klebsiella*, and *Proteus* species were occasionally isolated from the effluents. Major conclusions are (a) the Amicon DC-30 unit has only limited application for the concentration of enteroviruses from sewage effluents due to poor virus recovery rates and (b) the occasional isolation of viruses and pathogenic bacteria from the effluents indicates that some pathogens survive secondary sewage treatment.  
W79-05090

**PRELIMINARY RESULTS CONCERNING EFFECTS OF CHLORINE ON MONOSPECIFIC MARINE PHYTOPLANKTON,**  
Universite de Bretagne-Occidentale, Brest (France). Lab. de Physiologie Vegetale.  
C. Videau, M. Khalanski, and M. Penot.  
*Journal of Experimental Marine Biology and Ecology*, Vol 36, p 111-123, 1979. 6 fig, 4 tab, 24 ref.

Descriptors: \*Chlorine, \*Phytoplankton, \*Toxicity, \*Chlorophyta, Chlorination, Cytological studies, Mortality, Marine algal, Growth rates, Photosynthesis, Chlorophyll, Productivity, \*Dunaliella, \*Pavlova, \*Phaeodactylum.

Static chlorination tests have been carried out on three phytoplanktonic marine species, *Dunaliella primolecta*, *Pavlova lutheri*, *Phaeodactylum tricornutum*. These tests have led to the following conclusions. (1) The specific response and the sensitivity threshold of the algae tested: the chlorine LD 50 for the least dense culture (10 to the third power cells.ml-1) of *Dunaliella* and *Pavlova* is 0.4 and 4.0 ppm respectively, while the growth of *Phaeodactylum* is reduced or ceases at a chlorine concentration of 0.6 ppm. (2) Influence of cellular density: chlorine toxicity increases with decreasing cellular concentration (tests from 1000 to 10 to the sixth power cells.ml-1). (3) The effect on chlorophyll a concentration is not affected when the mortality due to the chlorine injection is <50%; the chlorophyll a concentration is greatly reduced for higher mortality. (4) Influence of light: chlorinations conducted in the dark produce a lower mortality, for *Dunaliella*, than chlorinations conducted in the light; the mortality is lower as long as the cultures are kept in the dark. (Deal-EIS)  
W79-05093

**PREDICTING EFFECTS OF COLD SHOCK: MODELING THE DECLINE OF A THERMAL PLUME,**  
Battelle Pacific Northwest Labs., Richland, WA. Ecosystems Dept.  
C. D. Becker, D. S. Trent, and M. J. Schneider.  
Available from the National Technical Information Service, Springfield, VA 22161 as PNL-2411. Price codes: A03 in paper copy, A01 in microfiche. Battelle, Pacific Northwest Laboratories Publication No PNL-2411, 32 p, 1977. 12 fig, 24 ref.

Descriptors: \*Water temperature, \*Cold resistance, \*Thermal pollution, \*Thermal stress, Adaptation, Powerplants, Outlets, Fish physiology, Animal metabolism, Heated water, Thermal powerplants, Sockeye salmon, Shiners, Bullheads, Fishkills, Mathematical models, \*Poikilotherms.

Predicting direct impact of cold shock on aquatic organisms after termination of power plant thermal discharges requires thermal tests that provide quantitative data on the resistance of acclimated species to lower temperatures. Selected examples from the literature on cold shock resistance of freshwater and marine fishes are illustrated to show predictive use. Abrupt cold shock data may be applied to field situations involving either abrupt or gradual temperature declines, but yield conservative estimates under the latter conditions.

Gradual cold shock data may be applied where heated plumes gradually dissipate because poikilotherms partially compensate for lowering temperature regimes. A simplified analytical model is presented for estimating thermal declines in terminated plumes originating from offshore, submerged discharges where shear current and boundary effects are minimal. When applied to site-specific conditions, the method provides time-temperature distributions for correlation with cold resistance data and, therefore, aids in assessing cold shock impact on aquatic biota. (Deal-EIS)  
W79-05094

**TOXICITY OF PHOSSY WATER TO SELECTED FRESHWATER ORGANISMS,**  
Army Armament Research and Development Command, Aberdeen Proving Ground, MD. Chemical Systems Lab.  
J. G. Pearson, P. F. Robinson, and E. S. Bender.  
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-054 374. Price codes: A02 in paper copy, A01 in microfiche. Aberdeen Proving Ground Report No. ARCSL-TR-78024, 21 p, 1978. 1 fig, 10 tab, 11 ref.

Descriptors: \*Phosphorus, \*Toxicity, \*Bioassay, Lethal limit, Mortality, Explosives, Chemical wastes, Sunfishes, Livebearers, Invertebrates, Water chemistry, Water analysis, Shrimp, Worms, Insects, Phosphates, \*Mosquito fish, \*Phossy water, Pine Bluff Arsenal, Pine Bluff, Arkansas.

Six species of freshwater organisms were exposed to the wastewater from a white phosphorus munitions filling facility, Pine Bluff Arsenal, Pine Bluff, Arkansas, in toxicity tests. Both fish (*Gambusia affinis* and *Lepomis macrochirus*) and benthic macroinvertebrates (*Clyptopendips* sp., *Palaemonetes kadiakensis*, *Chaoborus punctipennis*, and *Branchiura sowerbyi*), endemic to the area, were tested for periods of up to 96 hours. The median effective concentration (EC50) for all the invertebrates was between the LC50 for the bluegill (*L. macrochirus* 29.0 micrograms/l P4) and the mosquito fish (*G. affinis*, 75 micrograms/l P4). (Deal-EIS)  
W79-05095

**TRACE METAL CONTAMINATION OF THE ROCK SCALLOP, HINNITES GIGANTEUS, NEAR A LARGE SOUTHERN CALIFORNIA MUNICIPAL OUTFALL,**  
Southern California Coastal Water Research Project, El Segundo.  
D. R. Young, and T.-K. Jan.  
*Fishery Bulletin*, Vol. 76, No. 4, p. 936-939, 1979. 1 fig, 2 tab, 12 ref.

Descriptors: \*Heavy metals, \*Municipal wastes, \*Absorption, Chemical analysis, Animal physiology, Animal metabolism, Cadmium, Chromium, Copper, Mercury, Zinc, Lead, Nickel, Outlets, Path of pollutants, Bottom sediments, Water chemistry, Primary treatment, Sewage effluents, Los Angeles County, \*Scallops, \*Tissue analysis, \*Bioaccumulation, \*Silver.

The data presented indicate that the submarine injection of primary-treated municipal wastewater can lead to distinct trace metal contamination of filter-feeding rock scallops within a few kilometers of the discharge. Mean values for silver, cadmium, chromium, copper, mercury, and zinc in gonadal and/or muscle tissue of specimens collected near the Los Angeles County outfalls ranged from approximately 2 to 23 times the corresponding means for control specimens. These elevations do not appear to be artifacts caused by contamination from particulates in the digestive gland, but rather to result from actual physiological uptake of the metals. Although the results of this study point to a potential problem from waste metals discharged via municipal outfalls, we do not yet know the degree to which such elevated metals affect the rock scallop or its predators. (Deal-EIS)  
W79-05096

**THE NATURE OF METALS-SEDIMENT-WATER INTERACTIONS IN FRESHWATER**

**BODIES, WITH EMPHASIS ON THE ROLE OF ORGANIC MATTER,**  
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia). Petroleum Exploration Branch.  
For primary bibliographic entry see Field 5A.  
W79-05106

**AN EVALUATION OF THE STATUS, LIFE HISTORY, AND HABITAT REQUIREMENTS OF THE ENDANGERED AND THREATENED FISHES OF THE UPPER COLORADO RIVER SYSTEM. PART TWO,**  
Ecology Consultants, Inc., Fort Collins, CO.  
For primary bibliographic entry see Field 5A.  
W79-05114

**MESA NEW YORK LIGHT PROJECT ANNUAL REPORT FOR FISCAL YEAR 1977.**  
National Oceanic and Atmospheric Administration, Boulder, CO. Marine Ecosystems Analysis Program Office.  
NOAA/ERL Marine Ecosystems Analysis Program Report October 1978. 142 p, 8 fig, 3 tab, 2 plate, 4 append.

Descriptors: \*Water quality, \*Water pollution effects, \*Waste disposal, Oil pollution, Research facilities, New York, \*New York Bight, Annual reports.

The annual report for fiscal year 1977 presents an overview of MESA New York Bight Project activities between October 1, 1976 and September 30, 1977. The research results of the Project, focused on specific environmental issues, are highlighted under the following topics: contaminants of the New York Bight, New York Bight anoxia of 1976, sewage sludge dumping, and dredge spoil dumping. A bibliography lists the publications resulting from work supported by the New York Bight Project, and publications of the Project itself. (NOAA)  
W79-05116

**CHARACTERISTICS OF THE OSWEGO RIVER PLUME AND ITS INFLUENCE ON THE NEARSHORE ENVIRONMENT,**  
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.  
For primary bibliographic entry see Field 2E.  
W79-05118

**GROUND-WATER POLLUTION-A STATUS REPORT,**  
Illinois State Geological Survey, Urbana.  
For primary bibliographic entry see Field 5C.  
W79-05120

**GROUND-WATER POLLUTION-AN IMMEDIATE DISASTER,**  
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.  
For primary bibliographic entry see Field 5C.  
W79-05121

**GROUND-WATER POLLUTION-A LIMITED PROBLEM,**  
Dunn Geoscience Corp., Latham, NY.  
D. T. Clark.  
*Ground Water*, Vol. 17, No. 1, p. 25-27, January-February 1979.

Descriptors: \*Groundwater, \*Water pollution, \*Water pollution sources, \*Path of pollutants, Landfills, Leaching, Waste disposal, Chemicals, Sampling, Monitoring, Water supply, Groundwater movement, Pollutant identification.

Few would argue that groundwater pollution is a problem and that serious groundwater pollution problems do exist. As serious as some isolated groundwater pollution problems are, regionally and nationally, it is only a limited problem. An industrial landfill may result in a leachate plume

## Sources Of Pollution—Group 5B

contaminating groundwater over an area of up to several square miles downgradient from the disposal site. Municipal landfills or chemical/petroleum spills can result in polluted groundwater over areas measured in square miles. Surrounding these areas of groundwater pollution, however, are tens and hundreds of square miles of area where the groundwater moving through the aquifers maintains its natural good quality. The ratio of good quality to contaminated water is such that groundwater pollution can really only be considered as a limited problem. The problem will most likely remain limited as existing and future regulations continue to restrict the poor disposal practices that have been responsible for much of the past and existing pollution problems. Technology has advanced to the point that with proper management and sound governmental regulations, control, isolation, and cleanup of contamination sources and areas of polluted groundwater can be so effective that migration of the pollution front can be stopped and actually reversed with time. (Sims-ISWS) W79-05122

**GROUND-WATER QUALITY STANDARDS—A NEUTRAL VIEW.**  
Michigan Dept. of Public Health, Lansing.  
D. K. Keech.  
Ground Water, Vol. 17, No. 1, p 30-34, January-February 1979.

Descriptors: \*Groundwater, \*Water pollution, \*Water quality, \*Water quality standards, \*Michigan, Pollutants, Path of pollutants, Waste disposal, Irrigation, Industries, Chemicals, Monitoring, Sampling, Aquifers, Leaching, Landfills, Water resources, Hydrogeology.

An objective view of the need for groundwater quality standards requires that an individual recognize the value that groundwater contributes to the water supply needs of our nation. A vast number of people living in rural areas and a large number of communities are dependent upon groundwater as their sole source of water for domestic, industrial, commercial, and agricultural needs. This large use and dependency upon groundwater dictates that these resources are valuable and must be protected for both present day and future uses. There are many examples where present methods of disposal of wastes generated in America have not been satisfactory from an environmental standpoint, with an exception of projects where disposal sites have been properly designed, operated, and managed for protection of the groundwater. One possible solution for groundwater protection is the establishment of groundwater quality standards. The purpose of such standards is to protect the public health and welfare and to maintain the quality of groundwaters in all usable aquifers for individual, public, industrial, and agricultural water supplies. A legal basis must exist and the prescribed steps must be followed as dictated by the rule making process. The primary aim of such standards is to prevent the degradation of groundwaters such as they will not become a public health hazard or harm the users of the groundwater. (Sims-ISWS) W79-05123

**GROUND-WATER QUALITY STANDARDS—RELEVANT.**  
Environmental Protection Agency, Washington, DC. Office of Drinking Water.  
J. H. McDermott.  
Ground Water, Vol. 17, No. 1, p 35-38, January-February 1979.

Descriptors: \*Water quality, \*Water quality standards, \*Groundwater, Water pollution, Water pollution sources, Pollutants, Path of pollutants, Sampling, Monitoring, Waste disposal, Aquifers, Water supply, Hydrogeology, Regulation.

The opportunity to begin formulating a national groundwater quality protection program is at hand. In building the new program, we should use the host of lessons learned in the experience of related environmental programs. This is necessary so that the new program will be realistic at the

outset and congruent with the integrated planning and management of the ground- and surface-water resources of the nation. The keystone of program development, implementation, and evaluation is and will continue to be water quality standards. To the extent that the goal 'Safe Drinking Water for Americans' has already been established, the point-of-use regulations should serve as water quality objectives, thus facilitating groundwater program formulation and evaluation. The major regulatory thrust of the program, the water quality standards, must be technology-based site selection, construction and operational standards, with only limited monitoring in a conventional water supply and water pollution control context. (Sims-ISWS) W79-05124

**GROUND-WATER QUALITY STANDARDS—IRRELEVANT.**  
F. A. Rayner.  
Ground Water, Vol. 17, No. 1, p 39-44, January-February 1979.

Descriptors: \*Groundwater, \*Water quality standards, \*Water pollution, \*Legal aspects, Water pollution sources, Pollutants, Water quality, Path of pollutants, Water resources, Waste disposal, Irrigation, Sewage effluents, Aquifers, Regulation, Laws.

Proposals to establish national groundwater quality standards appear to be premature and redundant because of the geohydrologic and geochemical factors governing the occurrence and development of groundwater. Although it can be reasoned that there is no 'good time' to establish additional governmental standards (and the resultant additional governmental regulations), it can also be strongly argued that now is a 'bad time' to consider establishment of the proposed standards. First, a present mood of the general public is away from more governmental involvement in the business and private sectors, and a rebellion against the increasing cost of government. Second, the applicability and workability of present Federal (and some State) laws that could be used to adequately protect groundwater quality, have yet to be implemented or otherwise sufficiently tested. Equitable and workable groundwater quality protection could be fostered through the enactment of the long overdue requirements for the integration of surface- and groundwater development and management programs, without widening the existing gap between present groundwater and surface-water management structures. This integration would decrease inefficiency of use of these water resources—which are actually inseparable in identity to their users, the American taxpayers. (Sims-ISWS) W79-05125

**LAND APPLICATION OF WASTE—AN ACCIDENT WAITING TO HAPPEN.**  
Pirnie (Malcolm) Inc., Silver Spring, MD.  
C. C. Johnson, Jr.  
Ground Water, Vol. 17, No. 1, p 69-72, 1979. January-February, 1979. 14 ref.

Descriptors: \*Waste water disposal, \*Waste water treatment, \*Sewage effluents, \*Groundwater, Irrigation, Waste disposal, Water pollution sources, Water pollution, Pollutants, Path of pollutants, Soils, Groundwater movement, Water supply, Water wells, Aquifers, \*Land application, Land treatment.

Half the population depends on groundwater for domestic uses. Use is increasing 25% per decade. Groundwater is generally used with little or no treatment. Some persons would transfer the discharge of our waste products from contaminated surface streams to the land and thus relatively clean groundwaters. No standards exist that protect groundwater quality. Research necessary to give assurance that natural interaction of waste water and soils will remove, to acceptable levels, potentially harmful contaminants, organic and inorganic, that permeate today's waste streams and today's health concerns, has not been done. Success reports on land treatment of waste water have not evaluated deterioration of groundwater from

organic contamination. Most waste waters contain synthetic organics in varying concentrations. EPA recommends their reduction in drinking water to the lowest possible level. Most instances of groundwater contamination have been discovered after drinking water is contaminated. Unless the public is willing to treat groundwater as it does water from surface streams, greater control of land disposal practices must be exercised. Current practice does not indicate that necessary controls are contemplated or recognized. It follows that the widespread use of the land treatment alternative is, in reality, an accident waiting to happen. (Sims-ISWS) W79-05126

**THE FEDERAL GROUND-WATER PROTECTION PROGRAM—A REVIEW.**  
Environmental Protection Agency, Washington, DC. Office of Drinking Water.  
For primary bibliographic entry see Field 5G. W79-05127

**THE FEDERAL GROUND-WATER PROTECTION PROGRAM—TODAY'S HOPE.**  
Environmental Protection Agency, Dallas, TX.  
For primary bibliographic entry see Field 5G. W79-05128

**MIXING MODEL FOR LARGE STREAMS.**  
Vizgadzalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).  
L. Somlyódy.  
Progress in Water Technology, Vol. 10, No. 5/6, p 97-104, 1978. 8 fig, 21 ref.

Descriptors: \*Mixing, \*Rivers, \*Streams, \*Path of pollutants, \*Model studies, Mathematical models, Numerical analysis, Water quality, Pollutants, Tracers, Diffusion, Water pollution, Simulation analysis, \*Danube River.

In wide streams the variations in the water quality parameters are affected fundamentally by transverse mixing, which prohibits, in general, the use of one-dimensional water quality models. A two-dimensional mixing model applying to steady conditions was presented. The mixing model served as the basis for developing two-dimensional water quality models. The mixing model was formulated in a curvilinear coordinate system following the curvature conditions of the stream and contained depth integrated (average) values. The numerical solution based on the equations of the mass flux constant line, along which normal transport is zero, presents a visual geometric picture of the process. The difference scheme obtained is second order transversally, first order longitudinally, and explicit. Stability criteria of the solution were given, and the numerical solution was verified by checks against the possible analytical solutions. Practical applications of the model were illustrated by three numerical examples for the Danube. In the first the results of tracer observations were compared with those obtained analytically. The second applied to a 12 km long reach of the river. Actually observed  $NH_4^{+}$  values were compared to those obtained with the model. The pollution effect of a tributary stream was examined finally over a reach of 59.4 km length. A fair agreement between the values observed and computed demonstrated the validity of the model developed. (Sims-ISWS) W79-05133

**A MULTIVARIATE MODEL OF STORM-PERIOD SOLUTE BEHAVIOUR.**  
Exeter Univ. (Eng'and). Dept. of Geography.  
I. D. L. Foster.  
Journal of Hydrology, Vol. 39, No. 3/4, p 339-353, December 1978. 1 fig, 6 tab, 38 ref.

Descriptors: \*Storm runoff, \*Solutes, \*Pollutants, \*Model studies, Mathematical models, Runoff, Water pollution, Path of pollutants, Nutrients, Electrical conductance, Phosphorus, Calcium, Sodium, Magnesium, Chlorine, Flow, Rainfall, Precipitation (Atmospheric), Storms, Analytical



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

techniques, Water chemistry, Watersheds(Basins), Agricultural watersheds.

Three measures summarizing storm-period solute behavior and eight independent variables were employed in the development of stepwise multiple regression models in an attempt to identify the important hydrological and meteorological variables controlling solute response. The most appropriate predictive model of storm-period solute behavior was identified on the basis of the coefficient of determination, and the limitations of the models were discussed in relation to the stability of the multiple regression coefficients during each stage in independent variable selection. (Sims-ISWS) W79-05144

#### BISCAYNE AQUIFER, SOUTHEAST FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.

H. Klein, and J. E. Hull.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-291 250, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-107, September 1978. 52 p, 25 fig, 4 tab, 28 ref.

Descriptors: \*Aquifer characteristics, \*Path of pollutants, \*Groundwater movement, \*Pumping, \*Water supply, Municipal water, Water quality, Urban runoff, Septic tanks, Landfills, Leachate, Canals, Infiltration, Waste dilution, Groundwater recharge, Dispersion, Florida, \*Biscayne aquifer, \*Dade County, \*Broward County, Safe Drinking Water Act.

Peak daily pumpage from the highly permeable, unconfined Biscayne aquifer for public water-supply systems in southeast Florida in 1975 was about 500 million gallons. Another 165 million gallons was withdrawn daily for irrigation. Recharge to the aquifer is primarily by local rainfall. Discharge is by evapotranspiration, canal drainage, coastal seepage, and pumping. Pollutants can enter the aquifer by direct infiltration from land surface or controlled canals, septic-tank and other drainfields, drainage wells, and solid-waste dumps. Most of the pollutants are concentrated in the upper 20 to 30 feet of the aquifer; public supply wells generally range in depth from about 75 to 150 feet. Dilution, dispersion, and adsorption tend to reduce the concentrations. Seasonal heavy rainfall and canal discharge accelerate ground-water circulation, thereby tending to dilute and flush upper zones of the aquifer. The ultimate fate of pollutants in the aquifer is the ocean, although some may be adsorbed by the aquifer materials en route to the ocean, and some are diverted to pumping wells. (Woodard-USGS) W79-05155

#### ANALYSIS OF URBAN STORM-WATER-QUALITY FROM SEVEN BASINS NEAR PORTLAND, OREGON,

Geological Survey, Portland, OR. Water Resources Div.

T. L. Miller, and S. W. McKenzie.

Geological Survey open-file report 78-662, 1978. 47 p, 13 fig, 16 tab, 18 ref.

Descriptors: \*Water quality, \*Urban runoff, \*Storm runoff, \*Water analysis, \*Chemical analysis, Sediment transport, Suspended load, Dissolved solids, Coliforms, Nitrogen compounds, Turbidity, Biochemical oxygen demand, Correlation analysis, Analytical analysis, Sampling, Regression analysis, Oregon, \*Portland area.

Over a 1.5-year period, water-quality data were collected for seven small drainage basins in urban areas of Portland, Oregon. Analysis of the data followed three approaches. First, the constituent concentrations were analyzed. Average concentrations of suspended sediment, settleable solids, and fecal coliform bacteria generally exceeded levels expected for secondary waste-treatment plant effluent, whereas biochemical oxygen demand concentrations were lower than expected. The second analytical approach established correlations and bivar-

iate regression relationships between constituents for individual storms in each basin, for all storms in each basin, and for all storms in all basins. Generally, correlation coefficients decreased when progressing from data for individual storms in each basin, to data for all storms in each basin, to data for all storms in all basins. In the third approach, storm yields for 10 constituents were related to basin and precipitation characteristics by use of multiple-linear-regression techniques. Storm yields for suspended sediment varied by about four orders of magnitude. Generally, results of the multiple-regression analysis indicated that variations in storm yields were highly dependent on precipitation characteristics, with total rainfall of the storm frequently explaining most of the variation of the dependent variable. (Woodard-USGS) W79-05156

#### MAGNITUDES, NATURE, AND EFFECTS OF POINT AND NONPOINT DISCHARGES IN THE CHATTAHOOCHEE RIVER BASIN, ATLANTA TO WEST POINT DAM, GEORGIA,

Geological Survey, Doraville, GA. Water Resources Div.

J. K. Stamer, R. N. Cherry, R. E. Faye, and R. L. Kleckner.

Geological Survey open-file report 78-577, 1978. 74 p, 27 fig, 22 tab, 29 ref.

Descriptors: \*Water pollution sources, \*Inflow, \*Streams, \*Water analysis, \*Water pollution control, Streamflow, Flow rates, Data collections, Chemical analysis, Dissolved solids, Biochemical oxygen demand, Nitrification, Algae, Regulated flow, Urbanization, Powerplants, Thermal pollution, Waste water treatment, Georgia, \*Chattahoochee River, \*West Point Lake, \*Point-source discharge, Nonpoint-source discharge.

On an average annual basis and during the storm period of March 12-15, 1976, nonpoint-source loads for most constituents were larger than point-source loads at the Whitesburg station, located on the Chattahoochee River about 40 miles downstream from Atlanta, GA. Most of the nonpoint-source constituent loads in the Atlanta to Whitesburg reach were from urban areas. Average annual point-source discharges accounted for about 50 percent of the dissolved nitrogen, total nitrogen, and total phosphorus loads and about 70 percent of the dissolved phosphorus loads at Whitesburg. During a low-flow period, June 1-2, 1977, five municipal point-sources contributed 63 percent of the ultimate biochemical oxygen demand, and 97 percent of the ammonium nitrogen loads at the Franklin station, at the upstream end of West Point Lake. Dissolved-oxygen concentrations of 4.1 to 5.0 milligrams per liter occurred in a 22-mile reach of the river downstream from Atlanta due about equally to nitrogenous and carbonaceous oxygen demands. The heat load from two thermoelectric powerplants caused a decrease in dissolved-oxygen concentration of about 0.2 milligrams per liter. Phytoplankton concentrations in West Point Lake, about 70 miles downstream from Atlanta, could exceed three million cells per millimeter during extended low-flow periods in the summer with present point-source phosphorus loads. (Woodard-USGS) W79-05157

#### STORM-WATER DATA FOR BEAR CREEK BASIN, JACKSON COUNTY, OREGON, 1977-78,

Geological Survey, Portland, OR. Water Resources Div.

L. A. Wittenberg.

Geological Survey open-file report 79-217, 1978. 28 p, 1 fig, 5 tab, 7 ref.

Descriptors: \*Water quality, \*Storm water, \*Land use, \*Urban runoff, \*Water pollution, Water analysis, Dissolved solids, Nutrients, Bacteria, Lead, Sampling, Streamflow, Flow rates, Rainfall, Rain gages, Oregon, \*Bear Creek basin, Jackson County.

Storm-water-quality samples were collected from four subbasins in the Bear Creek basin in southern

Oregon. These subbasins vary in drainage size, channel slope, effective impervious area, and land use. Automatic water-quality samplers and precipitation and discharge gages were set up in each of the four subbasins. During the period October 1977 through May 1978, 19 sets of samples, including two base-flow samples, were collected. Fecal coliform bacteria colonies per 100-milliliter sample ranged from less than 1,000 to more than 1,000,000. Suspended-sediment concentrations ranged from less than 1 to more than 2,300 milligrams per liter. One subbasin consisting of downtown businesses and streets with heavy vehicular traffic was monitored for lead. Total lead values ranging from 100 to 1,900 micrograms per liter were measured during one storm event. (Woodard-USGS) W79-05171

#### FINGERLING AMERICAN SHAD: EFFECT OF VALIUM, MS-222, AND SODIUM CHLORIDE ON HANDLING MORTALITY,

Georgia Univ., Savannah. Coastal Plain Station. T. Murai, J. W. Andrews, and J. W. Muller. The Progressive Fish Culturist, Vol. 41, No. 1, p 27-29, 1979, 1 tab, 15 ref.

Descriptors: \*Salinity, Fish migration, Anadromous fish, Methodology, Fish physiology, Fish behavior, Mortality, Handling mortality, Fish handling facilities, Fish migration, \*Sodium chloride, \*Valium, \*MS-222, Shad.

Two experiments were conducted to study the effects of Valium, MS-222, and sodium chloride on the mortality induced by handling and transporting fingerling American shad. Fish that were given an oral administration of Valium (0.04 mg/kg fish) and transferred without removal from the water (water transfer), showed nearly 100% survival for 24 h in a polyethylene bag without any delayed mortality. Oral administration of Valium (0.08 mg/kg fish) did not prevent high mortality (more than 80%) when scale losses were excessive. Addition of sodium chloride to the transporting water (1%) showed a significant beneficial effect on survival for up to 4 h; however, it was not effective in preventing mortality caused by severe scale losses. MS-222 at a concentration of only 10 mg/L proved to be toxic to shad. (Katz-EIS) W79-05179

#### RAPID VACUUM METHOD FOR REMOVAL OF MUCUS FROM THE EPIDERMIS OF FISHES,

Louisville Univ., KY. Dept. of Biology.

For primary bibliographic entry see Field 5A.

W79-05180

#### PALAEMONID SHRIMP, MACROBRACHIUM AMAZONICUM: EFFECTS OF SALINITY AND TEMPERATURE ON SURVIVAL,

Texas Parks and Wildlife Dept., Ingram. Heart of Hills Fisheries Research Station.

W. C. Guest, and P. P. Durocher.

The Progressive Fish Culturist, Vol. 41, No. 1, p 14-18, 1979. 2 tab, 3 fig, 13 ref.

Descriptors: \*Shrimp, \*Water temperature, \*Salinity, Bioassay, Mortality, Sea water, Animal physiology, Crustaceans, Juvenile growth stages, Survival, Palaemonid shrimp, Macrobrachium, Aquaculture, Acute cold shock, Larvae, Larval growth stage, Optimal salinity.

Survival of larval Macrobrachium was evaluated at salinities of 0.0, 2.5, 5.0, 7.5, 10.0, 12.5, and 15.0‰. The effects of acute cold shock and a gradual temperature decline (2.0C/day) on larvae, postlarvae, and juveniles were also evaluated. Larvae metamorphosed to postlarvae at all salinities except 0.0‰; survival was 64% at 10.0‰ and 25% at 2.5‰. Larvae were most resistant to cold shock at 10.0‰ salinity. In gradually declining temperatures, all life stages began losing equilibrium at 14.0C. Shrimp held in salinities within their optimal range (10.0 - 12.0‰) were the most resistant to low temperatures. (Katz-EIS) W79-05181



## Sources Of Pollution—Group 5B

## COMPARATIVE STUDIES ON METHODS FOR DETERMINING TOTAL MERCURY IN FISH. DITHIZONE AND FLAMELESS ATOMIC ABSORPTION SPECTROPHOTOMETRY TECHNIQUES.

Instytut Technologii Żywności Pochodzenia Morakiego, Szczecin (Poland).  
M. Protasowicki, A. Ociepa, and A. Chodynicki.  
Zeszyty Naukowe Akademii Rolniczej w Szczecinie, Vol. 63 p. 55-62 1977, 2 tab, 25 ref. Polish, English Summary.

Descriptors: \*Chemical analysis, \*Spectrophotometry, \*Mercury, \*Herring, Laboratory tests, Analytical techniques, Path of pollutants, Heavy metals, Pollutant identification, Fish physiology, Methodology, Methyl mercury, \*Tissue analysis, \*Dithizone method.

Two methods for determining total mercury in fish were compared: the dithizone and flameless atomic absorption spectrophotometry techniques. The studies involved determination of recovery when 1 µg of mercury as solutions of HgCl<sub>2</sub> or CH<sub>3</sub>HgCl were added to each sample of herring flesh. Mean recoveries in the dithizone method were found to be 91.4 ± 7.47% and 90.25 ± 4.73% for the two solutions respectively, while the recoveries obtained with the flameless atomic absorption spectrophotometry were 95.00 ± 9.13% and 98.70 ± 7.14%, respectively. The results obtained with the dithizone method are comparable with those obtained with the flameless atomic absorption spectrophotometry for mercury contents of the magnitude order of 0.050 µg·g<sup>-1</sup>. (Deal-EIS)  
W79-05183

## CHANGES IN THE SPECIES COMPOSITION OF FISH IN THE RIVER LOT, Toulouse-3 Univ. (France). Lab. d'Hydrobiologie. J. N. Tourenne, and F. Dauba.

Annales de Limnologie, Vol. 14, No. 1-2, p. 133-138, 1978, 5 tab, 2 ref.

Descriptors: \*Reservoir construction, \*Reservoirs, \*Fish populations, Spatial distribution, Freshwater fish, Brown trout, Bass, Perches, Carp, Sunfishes, Construction, River flow, Water temperature, \*River Lot, France.

The disturbances in the river Lot caused by the construction of large reservoirs in the upper Lot and its tributary the Truyère have modified the distribution of the principal fish species, particularly in the barbel zone. However, the overall distribution of fish species in the river remains normal and downstream the distribution is characteristic of a lowland river with abundant fish. (Deal-EIS)  
W79-05184

## EARLY SAMPLES OF OIL IN WATER AND SOME ANALYSES OF ZOOPLANKTON, Torry Research Station, Aberdeen (Scotland). For primary bibliographic entry see Field 5A.

W79-05186

## THE ECOLOGICAL IMPACT ON AND NEAR SHORES BY THE AMOCO CADIZ OIL SPILL, Université de Bretagne-Occidentale, Brest (France). Inst. d'Etudes Marine. C. Chasse.

Marine Pollution Bulletin, Vol. 9, No. 11, p. 298-301, 1978, 2 tab, 1 fig, 3 ref.

Descriptors: \*Oil, \*Oil pollution, \*Water pollution effects, \*Amoco Cadiz, \*On-site investigation, Environmental effects, Ecology, Rocks, Rocky shores, Benthos, Littoral fauna, Seaweeds, Littoral algae, Crustacea, Shrimp, Bay of Morlaix, Molluscs, Gastropods, Ecological effects, Commercial fish.

By comparison with previous pollution accidents and taking into account the enormous quantity of oil spilled at Portall, the provisional balance sheet indicates rather less damage to the marine environment than might have been expected. (1) There is now evidence that intertidally and close inshore direct mortalities have been localized, seldom

heavy and always selective and partial. (2) Contamination of organisms and products of commercial fisheries at sea have been transitory. Oyster culture alone has been badly damaged. (3) The algal crop is now exploitable for industrial use. (4) The general cover of macro-algae has survived the incident. (Katz-EIS)  
W79-05190

## SURVIVAL OF SALMON SMOLTS IN SEA WATER AFTER EXPOSURE TO AIR-SUPER-SATURATED WATER, Corvallis Environmental Protection Agency, OR.

Western Fish Toxicology Station.  
A. V. Nebeker, D. G. Stevens, and R. J. Baker.  
The Progressive Fish Culturist, Vol. 41, No. 1, p. 30-32, 1979, 2 tab, 1 fig, 11 ref.

Descriptors: \*Bioassays, Laboratory tests, Salmon, \*Sockeye Salmon, \*Gas bubble disease, Fish diseases, \*Supersaturation, Atmospheric gases, Fish physiology, Sea water, Freshwater fish, Bioassay, Methodology, Laboratory experiment.

Smolts of sockeye salmon (*Oncorhynchus nerka*) were held at 117, 115, 113, 110, 108, and 100% saturation in air-supersaturated fresh water at 12.5°C for 3 weeks. At 117% saturation 70% of the fish died, and at 115%, 5% died. Survivors were severely stressed and exhibited many signs of gas bubble disease. When the smolts were transferred to sea water and held for 10 days, no deaths occurred and they recovered rapidly. (Katz-EIS)  
W79-05191

## BIRDS OILED DURING THE AMOCO CADIZ INCIDENT - AN INTERIM REPORT, Royal Society for the Protection of Birds Sandy (England).

P. H. Jones, J. Y. Monnat, C. J. Cadbury, and T. J. Stowe.  
Marine Pollution Bulletin, Vol. 9, No. 11, p. 307-310, 1978, 2 tab, 1 fig, 8 ref.

Descriptors: \*Oil, \*Oil spills, \*Water pollution effects, \*Amoco Cadiz, \*Birds, Bird types, Oiled birds, Mortality, Water birds, Atlantic Ocean, Puffins, Razorbills, Guillemots, Auk, Brittany, On-site investigations, Corpse drift experiment.

Over 4500 oiled birds were collected from beaches in Northwest France and the Channel Islands following the oil spillage from the Amoco Cadiz in March 1978. Auk were the most abundant casualties: 1391 puffins *Fratercula arctica*, 978 razorbills *Alca torda* and 731 guillemots *Uria aalge*, but there were also 126 divers *Gavia* spp. A total of 33 bird species were recorded oiled. A corpse drift experiment suggested that after 30 March at least 3450 seabirds died off north Finistere alone; the total mortality in the first fortnight of the incident was probably considerably larger. (Katz-EIS)  
W79-05192

## NOTES ON THE CONDITION IN SEPTEMBER 1978 OF SOME INTERTIDAL SANDS POLLUTED BY AMOCO CADIZ OIL, Marine Biological Association of the United Kingdom, Plymouth (England). Plymouth Lab.

N. A. Holme.  
Marine Pollution Bulletin, Vol. 9, No. 11, p. 302, 1978.

Descriptors: \*Oil, \*Oil spills, \*Amoco Cadiz, \*Water pollution effects, Beaches, Sediments, Sand spits, \*Sands, Sand discoloration, Littoral, Submerged oil, Surface sand, Benthos, Polychaetes, Molluscs, Toxicity, Meiofauna.

At the end of the summer a conspicuous feature of some beaches which had been heavily polluted by Amoco Cadiz oil spill six months previously was the strong development of grey or black layers close to the surface in sands which would not normally be discoloured at this depth. Recolonization of these beaches by meiofauna may be hindered by the reducing conditions. (Katz-EIS)  
W79-05193

## PRELIMINARY OBSERVATIONS ON POLLUTION OF THE SEA BED AND DISTURBANCE OF SUB-LITTORAL COMMUNITIES IN NORTHERN BRITAIN BY OIL FROM THE AMOCO CADIZ, Station Biologique de Roscoff (France).

L. Cabioch, J. C. Dauvin, and F. Gentil.  
Marine Pollution Bulletin, Vol. 9, No. 11, p. 303-307, 1978, 1 tab, 3 fig, 6 ref.

Descriptors: \*Oil, \*Oil spills, \*Water pollution effects, \*Amoco Cadiz, Brittany Coast, France, Benthos, Littoral, Sub-littoral, Sea-bed, Sediments, Currents (Water), Sea bed morphology, Benthos, \*Animal populations, Animal grouping, Estuaries, Bays, Bay of Morlaix, Benthic flora, Benthic fauna, Sediment pollution.

The final development of the disruption produced by hydrocarbons in sublittoral benthic communities is going to depend largely on two general conditions: on the one hand, on the natural capacity of the various types of habitat present to speed up or hinder their own cleansing; on the other, on the proximity of more or less large reserves for recolonisation. The peculiar benthic structure of northern Brittany, characterised by the presence of coarse, pebbly substrates continually exposed to strong tidal currents, has resulted in the harmful consequences of pollution being felt primarily by and even being concentrated in communities in fine sediment, isolated from each other in bays and estuaries. (Katz-EIS)  
W79-05194

## TOXICITY OF RESIDUAL CHLORINE COMPOUNDS TO AQUATIC ORGANISMS, Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.

G. L. Larson, C. E. Warren, F. E. Hutchins, L. P. Lamperti, and D. A. Schlesinger.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 236. Price codes: A06 in paper copy. Environmental Protection Agency, Ecological Research Series, EPA 600/3-78-023, March 1978, p. 105, 32 tab, 26 fig, 47 ref.

Descriptors: \*Chlorine, \*Chlorination, \*Toxicity, \*Bioassay, \*Water pollution effects, Mortality, Freshwater fishes, Sewage, Sewage treatment, Disinfection, Aquatic animals, Methodology, Trout, Salmon, Minnows, Bullhead, Bass, Sunfish, Crayfish, Juvenile fish, \*Chloramines.

Laboratory studies on the acute and chronic toxicity of chlorine and inorganic chloramines to trout, salmon, minnows, bullhead, largemouth bass, and bluegill were conducted. Acute toxicity under continuous and intermittent patterns of exposure as well as behavioral, reproduction, development, and growth responses to low level exposures to residual chlorine compounds were determined. Acute and chronic toxicities of chloramines to crayfish were investigated. Algae, invertebrates, including insects, and juvenile salmon were exposed continuously to relatively low levels of residual chlorine compounds in laboratory stream communities. The acute toxicities of inorganic chloramines, as measured by 96-hour LC50 values, were less than 100 µg/l for salmonids and were a function of life history stage, body size, and some water quality conditions. Whereas adult trout may live indefinitely at concentrations near 50 µg/l, the LC50 values for late developmental stages—fry and very small juveniles—were not much above this concentration. Effects on growth of alevins and juveniles had threshold concentration values between about 10 and 22 µg/l, effects being quite marked at 22 µg/l. In intermittent exposure to relatively high concentrations of free residual chlorine, mortality was found to be a rather consistent function of the area under the time-concentration curves of exposure, for different forms, durations, and frequencies of such patterns of exposure. Behavioral responses of fish, such as avoidance of chlorinated water which could be advantageous in nature and lethargic swimming, surfacing, and sinking to the bottom which would probably be harmful were studied. Such behaviors occur not only at acutely toxic concentrations but also at lower ones. (Katz-EIS)

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

W79-05197

**ENVIRONMENTAL PATHWAYS OF SELECTED CHEMICALS IN FRESHWATER SYSTEMS PART II: LABORATORY STUDIES,**  
SRI International Menlo Park, CA.  
For primary bibliographic entry see Field 5A.  
W79-05198

**INSECTICIDES: HCH, DDT, DDE, AND DDD IN SELECTED PACIFIC COMMERCIAL FISH SPECIES (IN POLISH),**  
Instytut Technologii Żywności Pochodzenia Morskiego, Szczecin (Poland).  
W. Cieroszko, and A. Chodnycki.  
Zeszyty Naukowe Akademii Rolniczej W Szczecinie, Vol. 63, p 47-54, 1977, 2 fig, 1 tab, 19 ref. (English summary).

Descriptors: \*Insecticides, \*Pesticide residues, \*DDT, DDE, DDD, \*Chlorinated hydrocarbon pesticides, Pesticide kinetics, Path of pollutants, Chemical analysis, Gas chromatography, Commercial fishing, Herrings, \*Tissue analysis, \*HCH, \*Sebastes, \*Theragra, \*Merluccius, \*Sole, Rockfish, Flatfish.

The mass application of chloroorganic insecticides, mainly HCH and DDT, has led to a considerable contamination of food products obtained from land and sea. Six Pacific fish species were examined, the insecticides being assessed by gas chromatography. Mean contents of DDT, DDE, and DDD in fish examined varied, the highest content of summative DDT being found in fat species like herring and Sebastes spp., 0.025-0.107 and 0.012-0.114 mg DDT kg<sup>-1</sup>, respectively. Lean fish yielded much lower contents (0.001-0.019 mg DDT kg<sup>-1</sup>). The HCH contents remained basically at the same level in all the species tested, the range being 0.0011-0.0042 mg HCH kg<sup>-1</sup>. The highest mean contents were attributed to DDE. In general, the Pacific fish were found to contain relatively small amounts of insecticides (HCH and DDT) as opposed to Baltic and North Atlantic fish. (Katz-EIS)  
W79-05199

**PREDICTING NIGHTTIME DISSOLVED OXYGEN DECLINE IN PONDS USED FOR TILAPIA CULTURE,**  
Alabama Univ., Auburn. Dept. of Fisheries and Allied Aquacultures.  
R. P. Romaine, C. E. Boyd, and W. J. Collins.  
Transactions of the American Fisheries Society, Vol. 107, No. 6, p 804-808, 1978, 1 fig, 3 tab, 9 ref.

Descriptors: \*Simulation analysis, \*Model studies, \*Dissolved oxygen, \*Tilapia, Mathematical models, Computer models, Biological communities, Freshwater fish, Respiration, Diurnal, Phytoplankton, Oxygen, Farm wastes, \*Farm ponds, Nutrients.

A computer simulation model for predicting nighttime dissolved oxygen (DO) loss was developed for manured and unmanured tilapia ponds. The model incorporated data from the literature on O<sub>2</sub> diffusion, respiration by the planktonic community, fish, and benthic organisms, and O<sub>2</sub> consumption by organic manure. The average absolute deviation between calculated and measured DO concentrations was 0.49 mg/liter for unmanured ponds and 0.38 mg/liter for manured ponds. The contribution of plankton respiration to the total DO loss averaged 75% and 80% in unmanured and manured ponds, respectively. The utility of the model for predicting DO loss over a wide range of plankton densities, fish standing crops, and percentage O<sub>2</sub> saturation values at dusk was demonstrated. The nighttime DO model should have universal applicability to other fish cultures provided a reliable method for estimating oxygen consumption by the cultured organism(s) is available. (Deal-EIS)  
W79-05200

**ANNOUNCEMENT OF COMPOUNDS REGISTERED FOR FISHERY USES,**  
National Fishery Research Lab., LaCrosse, WI.

For primary bibliographic entry see Field 5A.  
W79-05205

**THE RIOU-MORT A TRIBUTARY TO THE RIVER LOT POLLUTED BY HEAVY METALS. I. PRELIMINARY OBSERVATIONS ON THE CHEMISTRY AND BENTHIC ALGAE,**  
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.  
P. J. Say.  
Annales de Limnologie, Vol. 14, No. 1-2, p 113-131, 1978, 3 fig, 5 tab, 14 ref.

Descriptors: \*Water chemistry, \*Aquatic algae, \*Zinc, Water pollution effects, Chemical wastes, Industrial wastes, Toxicity, Aquatic populations, Chemical analysis, Water analysis, Suspended solids, \*Cadmium, \*Copper, Sulfuric acid, \*Manganese, Cladophora, Rivers, \*Smelters, Riou-Mort, River Lot.

The Riou-Mort drains the heavily industrialized coal-bearing basin of Decazeville and is therefore the principal receiver of a diverse range of waste waters. Studies were made of the chemistry and benthic algae at 14 sites on the Riou-Mort and its tributaries and 7 sites on the river Lot. The former river and its tributaries are all severely polluted below the main centres of industry after receiving effluents discharged from a number of factories including a zinc smelter. The principal pollutants are suspended solids, zinc, cadmium, copper, sulphuric acid and manganese. Marked changes in the benthic algal flora occur below the sources of pollution on all the rivers. Under conditions of 'moderate' heavy metal pollution communities dominated by Cladophora glomerata, Ullothrix zonata, Vaucheria sp., Melosira varians and Synechococcus are replaced by those dominated by Stigeoclonium tenue, Gomphonema crassum, Gomphonema parvum and Surirella ovata. Under extreme heavy metal pollution at certain sites no algal species were found whilst at others the flora is reduced to two species Gomphonema parvum and Achnanthes minutissima. A combination of high levels of suspended solids and high concentrations of zinc and cadmium produce the most severe effects on the benthic algae. (Deal-EIS)  
W79-05206

**CONCENTRATIONS OF SELECTED ELEMENTS AND ASH IN BLUEGILL (LEPOMIS MACROCHIRUS) AND CERTAIN OTHER FRESHWATER FISH,**  
Breedlove Associates, Inc., Gainesville, FL.  
For primary bibliographic entry see Field 5A.  
W79-05208

**THE USE OF COPPEROXYCHLORIDE DURING LARVAL GROWTH AS A PREVENTATIVE MEASURE AGAINST THE SPREAD OF CILIATA-EXOPARASITES,**  
Warmwater Fish Hatchery (Hungary).  
L. Horvath, M. Lang, and G. Tamas.  
Bamidgeh, Vol. 30, No. 3, p 80-84, 1978, 2 tab, 13 ref.

Descriptors: \*Fish parasites, \*Carp, \*Protozoa, Zooplankton, Toxicity, \*Copper compounds, Chlorides, Larval growth stages, Metals, Fish farming, Copper sulfate, Fish physiology, Mortality, Fish management, \*Tissue analysis, \*Copperoxychloride.

Some copper compounds seemed to be likely candidates for prevention of parasite evoked damage to farmed larvae and fry of cyprinid fish (carp, silver-carp, grass-carp, and tench). Instead of the well known and effective but at the same time poisonous copper sulfate, we used the less toxic copperoxychloride. Before treatment of ponds, concentrations effective against parasites were determined under laboratory conditions. The therapeutic dose proved to be 4 mg/l; only twenty fold concentrations (i.e. 80 mg/l) were toxic to the fish. In pond treatments parasites were eliminated by the copper compound at a concentrations of 4 mg/l. When changes in technology were also instituted, fish developed well and there was no renewal of infection. (Deal-EIS)

W79-05209

**APPLICATION OF PHASED COOLING TO A ONCE-THROUGH COOLING SYSTEM,**  
Auburn Univ., AL. Dept. of Mechanical Engineering.  
J. A. MacFarlane, G. Maples, and D. F. Dyer.  
Journal of Engineering for Power, American Society of Mechanical Engineers, p 365-367, July 1976, 5 fig. OWRT-A-039-ALA(1).

Descriptors: \*Powerplants, \*Cooling water, Heated water, \*Thermal pollution, Phased cooling.

The use of once-through cooling for high capacity generating units, is becoming increasingly impractical. Since passage for the Federal Water Pollution Control Act of 1965, the maximum allowable increase in water temperature for rivers and streams is 5F. For a large power plant, this 5F rise requires a condenser flow rate which surpasses the average flow of most rivers in the United States. Through employment of the 'phase-cooling' concept however, an alternative form of once-through cooling can be developed which will meet the Federal Water Pollution Control Act standards. The model and equations used are similar to those described elsewhere. (See also W79-05228)  
W79-05227

**REJECTION OF WASTE HEAT FROM POWER PLANTS THROUGH PHASED-COOLING,**  
Auburn Univ., AL. Dept. of Mechanical Engineering.  
J. A. MacFarlane, J. S. Goodling, and G. Maples.  
Journal of Engineering for Power, American Society of Mechanical Engineers, p 117-124, January 1975, 7 fig, 21 ref. OWRT-A-031-ALA(4).

Descriptors: \*Cooling water, Powerplants, \*Thermal pollution, Heated water, Storage ponds, Cooling ponds, Phased cooling.

Because of the disadvantages associated with present power plant cooling systems, a new concept in waste heat dissipation, called 'phased-cooling,' is introduced. Heated condenser cooling water is held in a storage pond during certain hours of the day, to be cooled at a later time by traveling across a cooling surface. A thermodynamic analysis of the system is performed, and the equations of heat transfer from a water surface are presented. The developed model is then used for prediction of system performance. The optimum number of storage hours is shown to be dependent upon the size of the system, the season, and meteorological conditions. Phased-cooling evaporation losses are approximately 40 percent less than those of cooling towers and cooling ponds. Condenser inlet temperatures are significantly lower than those of cooling ponds of similar size.  
W79-05228

**IDENTIFICATION OF MAJOR ORGANIC CONSTITUENTS IN TEXTILE WASTE WATER RESULTING FROM THE USE OF SULFUR DYES,**  
Auburn Univ., AL. Dept. of Consumer Affairs.  
B. L. Slaten.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 359, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute, Auburn University, Bulletin 35, March 1979, 14 p, 8 ref. OWRT A-053-ALA(1).

Descriptors: \*Organic compounds, \*Textile wastes, Sulfur dyes, Dyes, Chromatography, XAD-2 resin.

The waste water from textile dyeing facilities contains many organic contaminants. A laboratory simulation of the sulfur dyeing of cotton fabrics was done in order to determine the nature of the by-products normally discharged in textile waste water systems. The organic constituents resulting from these laboratory dyeings were removed from water solution using liquid-solids chromatography and XAD-2 resin. The organic fractions so ob-



## Effects Of Pollution—Group 5C

tained in several eluting solvents were further separated by a second separation using silica gel chromatography. These fractions were then examined using various analytical techniques. It was determined that the waste water resulting from sulfur dyes contained in excess of 200 different organic constituents varying in molecular weight and nature of functional groups.  
W79-05230

# MIXING OF POWER-PLANT HEATED EFFLUENTS WITH THE MISSOURI RIVER,

Iowa Univ. Iowa City. Inst. of Hydraulic Research.  
R. Caro-Cordero, and W. W. Sayre.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 633. Price codes: A07 in paper copy, A01 in microfiche. IHR Report No. 203, June 1977. 141 p, 56 fig, 9 tab, 20 ref, 2 append.

Descriptors: \*Model studies, \*Thermal powerplants, \*Missouri River, \*Heated water, \*Mixing, \*River flow, \*Water cooling, \*Hydraulics, \*Turbulent flow, \*Channel morphology, \*On-site investigations, \*Temperature, \*Mixing, \*Thermal plumes, \*Temperature distribution, \*Transverse mixing.

Thermal plume data obtained in the Missouri River downstream from the Fort Calhoun and Cooper Nuclear Stations, together with detailed information about the channel geometry needed to synthesize the transverse flow distribution, were used to adapt and refine a mathematical model for steady-state transverse mixing in natural streams for the purpose of predicting thermal plumes in fast-flowing turbulent rivers such as the Missouri River. In addition to the transverse distribution of flow, the model requires two parameters, one relating to the initial near-field dilution resulting from the interaction of the thermal discharge with the ambient flow, and the other governing the far-field transverse mixing due to mechanism associated with the ambient flow. Twelve sets of plume data were analyzed to determine the values of the parameters which provide the best agreement between observed and computed distributions of temperature rise with respect to cumulative discharge across the channel. The model was shown to provide a good basis for predicting thermal plumes in the Missouri River and similar streams. (Singh-ISWS)  
W79-05245

# ACOUSTIC MONITORING OF INDUSTRIAL CHEMICAL WASTE RELEASE AT DEEP WATER DUMP SITE 106,

Woods Hole Oceanographic Institution, MA. Dept. of Ocean Engineering.  
M. H. Orr, and F. R. Hess.  
Journal of Geophysical Research, Vol. 83, No. C12, p 6145-6154, December 20, 1978. 10 fig, 16 ref. NOAA 04-6-158-40072, 7-35181.

Descriptors: \*Waste disposal, \*Chemical wastes, \*Remote sensing, \*Acoustics, \*Waste dumps, \*Continental slope, \*Dispersion, \*Flocculation, \*Chemical precipitation, \*Dye releases, \*Dye dispersion, \*Oceans, \*Pollutants, \*Path of pollutants, \*Mixing, \*Water pollution, \*Monitoring, \*Industrial chemical wastes.

Some industrial chemical wastes form flocs or particles upon being introduced into seawater. High-frequency acoustic backscattering systems were used to study the dispersion of the particulate phase of industrial chemical waste in a water column (depths of more than 1500 m) with a sharp seasonal thermocline. The particles were found to remain trapped for extended periods (at least 74 hours) in the mixed layer, to accumulate on the density structure found between the mixed layer and the seasonal thermocline, to accumulate on the density structure associated with the seasonal thermocline, and on occasion, to penetrate the seasonal thermocline and form a diffuse cloud in the main thermocline. The effluent phase of the chemical waste, which was tagged with rhodamine WT dye, was found to remain in the vicinity of the particulate phase of the waste. (Sims-ISWS)  
W79-05264

# OUTPUT OF WATER, SUSPENDED SEDIMENT, AND PHOSPHORUS FORMS FROM A SMALL AGRICULTURAL CATCHMENT,

Marlborough Catchment and Regional Water Board, Blenheim, (New Zealand).  
B. J. Bargh.  
New Zealand Journal of Agricultural Research, Vol. 21, No. 1, February 1978, p 29-38. 4 fig, 4 tab, 25 ref.

Descriptors: \*Agricultural runoff, \*Phosphorus, \*Nitrogen, \*Suspended solids, \*Streamflow, \*Tuapaka Catchment(New Zealand), \*Path of pollutants, \*Water pollution sources, \*Tararua Ranges(New Zealand), \*New Zealand, \*Watersheds(Basins), \*Percolation, \*Rainfall, \*Storm runoff, \*Fertilization, \*Phosphates, \*Nitrogen fixation, \*Clover, \*Particulates, \*Nutrients, \*Sedimentation, \*Manawatu River(New Zealand).

A one-year study (1974-75) outputs of water, suspended sediment, and phosphorus and nitrogen forms from the 180-ha Tuapaka Catchment, an agricultural area in the northern Tararua Ranges, New Zealand, showed that 26% of total rainfall was discharged as streamflow. Significant quantities of phosphorus and nitrogen were associated with suspended sediment output, which amounted to 1400 kg/ha. Of the annual loss of total phosphorus (1.6 kg/ha), 76% was particulate, and of the 5.2 kg/ha annual output of total nitrogen, 14% was particulate. Phosphate fertilizer application was the major source of phosphorus input, and clover nitrogen fixation and rainfall the major nitrogen sources. Average annual rainfall in New Zealand is 1000 mm, uniform throughout the year; during the study year rainfall was 1048 mm. The catchment rises 80-400 m a.s.l., and drains into the Manawatu River. A water balance estimate for the basin indicated minimal deep percolation. Baseflow events during the drier summer months were about one liter/sec, increasing to 10 liters/sec during winters. Peak storm discharges varied from 100-2870 liters/sec. A total of 273.1 mm of annual rainfall (26%) was discharged as streamflow. Total suspended sediment discharged was 252 t. The pattern of suspended sediment output apparently depended on antecedent moisture content, rainfall quality and intensity, and land management. Total dissolved load was 31.8 t (11% of the total load). (Lynch-Wisconsin)  
W79-05344

# SOME ASPECTS OF SEDIMENT DISTRIBUTION AND MACROPHYTE CYCLING OF HEAVY METALS,

Purdue Univ., Lafayette, IN. Dept. of Bionucleonics.  
For primary bibliographic entry see Field 5C.  
W79-05353

# REMOTE SENSING FOR OIL POLLUTION CONTROL ALONG COASTAL WATERS OF THE UNITED STATES,

Coast Guard Research and Development Center, Groton, CT.  
For primary bibliographic entry see Field 7B.  
W79-05393

# EVALUATION OF THE EFFECTS OF URBANIZATION ON STORMWATER RUNOFF AND QUALITY,

Tennessee Univ., Knoxville. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 4C.  
W79-05400

# STORMWATER MANAGEMENT MODEL: TRANSFER OF TECHNOLOGY,

Environmental Protection Agency, Washington, DC. Office of Research and Development.  
H. C. Torno.  
In: Water Knowledge Transfer. Volume 2, Proceedings of the Second International Conference on Transfer of Water Resources Knowledge, June 1977, Fort Collins, Colorado. N.S. Grigg, et al., Editors, Water Resources Publications, Fort Collins, Colorado, 1978, p 587-591.

Descriptors: \*Storm water, \*Management, \*Technology transfer, \*Programs, \*Mathematical models, \*Urban drainage, \*Simulation analysis, \*Systems analysis.

Since its development in 1970, the U.S. Environmental Protection Agency's Storm Water Management Model (SWMM) has become the most widely used urban drainage model in the United States and Canada, and it has received extensive application in other countries. While the principle reason for this is conceptual soundness and utility, an effective technology transfer program has been central to its continued popularity with engineers and planners in both the public and private sectors. There are numerous key ingredients in the success of this technology transfer program. Included are: (1) good model documentation, including test data, which is updated concurrently with model changes; (2) a simple, informal and responsive mechanism for making the model available to users; (3) workshops to train potential users; and (4) a continuing commitment to maintain the model. Except for the last of these, technology transfer is accomplished with a minimal expenditure of resources. The SWMM Users Group currently numbers some 275 firms and individuals, and meetings feature a wide variety of presentations, including information on the application of a wide variety of models. (See also W79-05409) (Bell-Cornell)  
W79-05412

# REFINER PULP MILL EFFLUENT. PART 2. COMPOSITION OF DISSOLVED SOLIDS FRACTION,

New Zealand Forest Service, Rotorua.  
S. R. Corson, and J. A. Lloyd.  
Paperi ja Puu, Vol. 60, No. 3, p 435-439, August, 1978. 2 fig, 3 ref, 7 tab.

Descriptors: \*Pulp wastes, \*Dissolved solids, \*Groundwood mills, \*Suspended solids, \*Dissolved solids, \*Wastes, \*Industrial wastes, \*Water pollution sources, \*Pulp and paper industry, \*Effluents, \*Carbohydrates, \*Color, \*White water(Paper machine), \*Fatty acids, \*Resin acids, \*Organic compounds.

Most of the dissolved solids in the white-water and effluent streams of refiner groundwood (chip groundwood) mills are derived from carbohydrates. These compounds amount to 2000-3000 mg/liter in the white-water overflow and are responsible for the characteristic brown color of the effluent. Small quantities (100-200 mg/liter) of ether-soluble extractives were also present in white water. Resin acids in the effluent amounted to 40 mg/liter. The ratio of resin acids to fatty acids in the dissolved effluent solids was as high as 80:20, compared to 40:60 in the suspended solids and 55:45 in the pulpwood entering the mill and in the pulp fiber leaving it. (Brown-IPC)  
W79-05496

## 5C. Effects Of Pollution

# EFFECT OF PHOSPHORUS SUPPLY ON ALGAL BIOMASS IN A TURBID MISSOURI RESERVOIR,

Missouri Univ.-Columbia. Dept. of Civil Engineering.  
J. T. Novak, P. J. Jones, C. Crisp, N. Crisp, and F. Cunningham.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 183. Price codes: A06 in paper copy, A01 in microfiche. Missouri Water Resources Research Center, University of Missouri Completion Report, March 1979. 104 p, 51 fig, 4 tab, 44 ref. OWRP A-095-MO(1), 14-34-0001-7053, 7054, 8027.

Descriptors: \*Phosphorus, \*Chlorophyll, \*Turbidity, \*Primary production, \*Lakes, \*Algal blooms, \*Biomass.

The objective was to determine the relationship between primary productivity and phosphorus levels in the Lake of the Ozarks. The Lake of the Ozarks is large man-made impoundment that is fed



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

primarily by the Osage River. Although this river contains a large quantity of phosphorus, productivity is low. This research was designed to clarify the relationship between suspended solids levels and phosphorus availability. Data obtained suggest that inorganic phosphorus entering the Lake of the Ozarks may not have as great an impact on productivity as point source inputs. Productivity is limited because of the high flushing rates in the lake and because of limited availability of bound phosphorus. The data further indicate that light availability may not be as important in turbid man-made reservoirs as the impact of silt on phosphorus availability. When this study began it was a goal to evaluate the impact of impounding the Osage River upstream of the Lake of the Ozarks. Although not conclusive, it appears that the impoundment may improve water quality by decreasing the turbidity level in the Osage arm of the Lake of the Ozarks and reducing phosphorus inputs.

W79-05001

#### BIOLOGICAL ASSESSMENT OF TIMBER MANAGEMENT ACTIVITY IMPACTS AND BUFFER STRIP EFFECTIVENESS ON NATIONAL FORESTS STREAMS OF NORTHERN CALIFORNIA

California Univ., Berkeley. Dept. of Forestry and Conservation.

K. B. Roby, D. C. Erman, and D. J. Newbold. Earth Resources, Monograph No. 1, Forest Service/USDA, Region 5, California, December 1977. 169 p, 3 fig, 12 tab, 11 append. (California Water Resources Center Project UCAL-WRC-W-411), OWRT A-047-CAL(4).

Descriptors: \*Invertebrates, \*Lumbering, \*Biological communities, \*Vegetation effects, \*Environmental effects, Erosion control, Bank stability, Bank protection, Watershed management, Forest management, Slope protection, Cutting management, Running waters.

A method for assessment of logging impacts on water quality, using aquatic invertebrate communities, is presented. The analysis is based on comparison of invertebrates taken from one logged and two unlogged streams. 'Community diversity' (as Shannon Diversity Index) and 'ecological distance' (as Euclidean distance) are used in tandem to evaluate the impact of timber management practices. Analysis based on identification of organisms to the generic level gave best results, but those based on family level determinations also yielded statistically significant results. The method was developed from a research project which sampled 62 streams in northern California. The results showed aquatic invertebrate communities were significant indicators of streams logged without adequate protective measures. Streams with narrow buffer strips were variable in provision of protection, but those streams with buffers greater than 30m in width showed no effects of logging. In addition to invertebrate analysis, chemical and physical parameters of water quality were sampled. Only one parameter, stream channel stability ratings, was effective in distinguishing between logged and unlogged streams. The data provide a comprehensive picture of existing conditions in northern California streams. (Snyder-Calif. Davis)

W79-05005

#### DIATOM COMMUNITY STRUCTURE: TAXONOMIC AND STATISTICAL ANALYSES OF A MISSISSIPPI SALT MARSH

Mississippi State Univ., Mississippi State. Dept. of Botany.

M. J. Sullivan. Journal of Phycology, Vol. 14, No. 4, 468-475, December 1978. 3 fig, 4 tab, 13 ref. OWRT A-099-MISS(4), 14-34-0001-7052.

Descriptors: \*Diatoms, \*Salt marshes, \*Soil algae, Ecological distribution, Biogeography, Biological communities, Mississippi, Bulrush, Graveline Bay Marsh(Miss), Spartina, Juncus, Distichlis, Navicula.

Edaphic diatoms were collected on a seasonal basis from beneath five monospecific stands of spermatophytes on Graveline Bay Marsh (Mississippi) from 14 October 1976 through 21 June 1977. Of the 119 diatom taxa encountered, only seven were restricted to a single edaphic habitat, and five of these accounted for 17.2% of the individuals comprising the community associated with *Distichlis spicata* (L.) Greene. The most abundant diatom was *Navicula tripunctata* (Mull.) Bory, which accounted for 21.5% of all individuals counted during the study. Based on a 2-way ANOVA of species diversity ( $H'$ ) and the number of taxa in a sample, edaphic diatom community diversity was highest beneath *D. spicata* and *Spartina patens* (Alt.) Muhl., lowest beneath *Sp. alterniflora* Loisel. and *Juncus roemerianus* Scheele, and somewhat intermediate for the *Scripus olneyi* Gray habitat. Structural differences between selected community pairs were quantified using a similarity index (SIMI) and the values generated were exceedingly variable. A multiple regression analysis revealed that structural differences among edaphic diatom communities were related to differences in elevation, far red light energy, ammonia nitrogen, soil moisture, and tentatively, height of the spermatophyte canopy.

W79-05007

#### COPPER, NICKEL, AND ZINC RELEASED FROM ACID COAL MINE SPOIL MATERIALS OF EASTERN KENTUCKY

Kentucky Univ., Lexington. Div. of Regulatory Services.

For primary bibliographic entry see Field 5A. W79-05044

#### PRELIMINARY RESULTS CONCERNING EFFECTS OF CHLORINE ON MONOSPECIFIC MARINE PHYTOPLANKTON

Universite de Bretagne-Occidentale, Brest (France). Lab. de Physiologie Vegetale.

For primary bibliographic entry see Field 5B. W79-05093

#### PREDICTING EFFECTS OF COLD SHOCK: MODELING THE DECLINE OF A THERMAL PLUME

Battelle Pacific Northwest Labs., Richland, WA. Ecosystems Dept.

For primary bibliographic entry see Field 5B. W79-05094

#### TOXICITY OF PHOSSY WATER TO SELECTED FRESHWATER ORGANISMS

Army Armament Research and Development Command, Aberdeen Proving Ground, MD. Chemical Systems Lab.

For primary bibliographic entry see Field 5B. W79-05095

#### TRACE METAL CONTAMINATION OF THE ROCK SCALLOP, *HINNITES GIGANTEUS*, NEAR A LARGE SOUTHERN CALIFORNIA MUNICIPAL OUTFALL

Southern California Coastal Water Research Project, El Segundo.

For primary bibliographic entry see Field 5B. W79-05096

#### POLLUTION-ASSOCIATED DISEASES AND ABNORMALITIES OF FISH AND SHELLFISH: A REVIEW

National Marine Fisheries Service, Highlands, NJ. Sandy Hook Sport Fisheries Marine Lab.

C. J. Sindermann. Fishery Bulletin, Vol. 76, No. 4, p 717-749, 1979. 8 fig, 235 ref.

Descriptors: \*Fish diseases, \*Animal pathology, \*Toxicity, Water pollution effects, Shellfish, Crustaceans, Viruses, Pathogenic bacteria, Infection, Chlorinated hydrocarbon pesticides, Genetics, Animal physiology, DDT, Polychlorinated biphenyls, 2,4-D, Chemical wastes, Industrial wastes,

Pesticides toxicity, Fish physiology, Mollusks, Fin erosion, \*Tissue analysis, Neoplasms, Mutagens.

The relationship of disease and environmental stress is becoming increasingly well established with time. Human activities-particularly those that result in chemical additions to the coastal/estuarine environment have increased the potential stresses on fish and shellfish inhabiting those areas. Circumstantial evidence for associations of pollutants with certain fish and shellfish diseases and abnormalities is accumulating. This paper attempts to review and evaluate existing information about associations of diseases and marine environmental degradation. Emphasis has been placed on: diseases caused by contaminant stress and related facultative pathogens; stress-provoked latent infections; environmentally induced abnormalities, genetic abnormalities associated with mutagenic and other properties of contaminants; experimentally induced lesions; contaminant effects on resistance and immune responses; and pollutant-parasite interactions. There are several diseases, particularly fin erosion and ulcers in fish and shell diseases in crustaceans, for which a relationship with pollution seems evident, and there are a number of other diseases or abnormalities (such as certain neoplasms and skeletal anomalies) for which a relationship with pollution is indicated. Furthermore, there is some evidence that certain latent viral infections may be provoked into patency by environmental stress. (Deal-EIS)

W79-05097

#### THE INFLUENCE OF TURBIDITY ON NET PHYTOPLANKTON PHOTOSYNTHESIS IN SOME IRISH LAKES

New Univ. of Ulster, Coleraine (Northern Ireland). Limnology Lab.

D. H. Jewson, and J. A. Taylor. Freshwater Biology, Vol. 8, p 573-584, 1978. 12 fig, 2 tab, 39 ref.

Descriptors: \*Photosynthesis, \*Phytoplankton, \*Euphotic zone, \*Turbidity, Chlorophyll, Lakes, Light, Aquatic algae, Nutrients, Light penetration, Light quality, Light intensity, Spectrophotometry, Optical properties, Ulster, L. Neagh, Northern Ireland.

An important influence on gross photosynthetic rates per unit area is the success with which phytoplankton competes for the available light with non-algal suspended material and dissolved organic compounds. Using a range of Irish lakes, with euphotic zones varying between 0.7 and 20 m and with chlorophyll-a values between 1 and 860 mgm<sup>-3</sup>, the effect on gross rates of photosynthesis is analysed for changes in the balance between the factors contributing to light attenuation. Net values per unit are also likely to be modified in well-mixed systems as the ratio of light to dark regions in the water column are altered with changes in light penetration. Depth gradients in dark respiration are reported for L. Neagh which vary according to previous light history and nutrient stress. Possible cases of restraint on phytoplankton growth are discussed for optically deep situations. (Deal-EIS)

W79-05098

HISTOPATHOLOGICAL CHANGES IN THE FISH AFTER INTOXICATION WITH NON-IONOGENIC TENSIDES ON THE BASIS OF ETHOXYL ADUCTS OF ISONONYLPHENOLS (HISTOPATOLOGICKE ZMENY U RYB PO INTOXIKACI NEIONOGENNIMI TENZIDY NA BAZI ETHOXYLOVYCH ADUKTU ISONONYLFENOLU), Vysoka Skola Veterinarni Brno (Czechoslovakia). L. Groch, and Z. Svobodova. Bulletin Vurh Vodnany, Vol. 14, p 19-26, 1978. 6 fig, 2 tab, 16 ref.

Descriptors: \*Toxicity, \*Rainbow trout, \*Carp, Chemical analysis, Chemical properties, Fish physiology, Animal metabolism, Animal pathology, Phenols, Organic compounds, Cytological studies, Detergents, \*Tissue analysis, \*Gills.

The organo-ionic effect of isononyl subjected worst than of the fish in the gill accompanied by epithelial served in a (Deal-EIS) W79-05099

BEHAVIORAL FISH, H. Marcu. In: The Behavior of Fish, 133 ref, Ac.

Descriptive, Chemistry, Biology, Fish, Act, \*Ethanol.

An examination shown the response variety of tion, and er, several ly apparent of studies most of the data. Thus learning is very little individuality between these experiments major pre-cologists and contr extended vide behav yardstick nient and ants. Onc and enviro determine that will hardship (EIS) W79-05101

EFFECT SHORT FAUSIS National Northwe D. R. Cr Fishery l fig, 1 tab

Descript Entrainm Cooling powerpl bution p mation.

Thermal system v ture inc periods indicate condens could ki thermal sion, pre minimize condens deep en cooling in the (100m) v of eupha W79-05102

## Effects Of Pollution—Group 5C

The organs and tissues of fishes intoxicated by non-ionogenic tensides on the basis of ethoxyl adducts of isononylphenols (Slovafo 905, 909, 915) were subjected to histopathological examination. The worst changes were found in the respiratory tract of the fishes. Pronounced congestion was observed in the gill fringes and filaments. This condition was accompanied by atrophic damage to the respiratory epithelium. Circulatory disturbances were observed in almost all the organs and tissues studied. (Deal-EIS)

W79-05099

# BEHAVIORAL TOXICOLOGY AND TELEOST FISH,

H. Marcucella, and C. I. Abramson.

In: *The Behavior of Fish and Other Aquatic Animals*, D. I. Mostofsky; ed., p. 33-77, 1978. 12 fig, 133 ref, Academic Press, New York.

Descriptors: \*Toxicity, \*Fish behavior, \*Variability, Chemical wastes, Industrial wastes, Fish physiology, Animal behavior, Carp, Chemical properties, Biochemistry, Learning, Conditioning, Goldfish, Actinomycin, \*Piracetam, \*Scotophobin, \*Ethanol, \*Puromycin.

An examination of the fish learning literature has shown that a variety of responses can be either respondently or operantly conditioned and that a variety of chemicals affect the acquisition, retention, and maintenance of these responses. However, several limitations of the existing data are readily apparent. Although there are literally hundreds of studies examining learning phenomena in fish, most of these studies have provided only group data. Thus, much information is available about learning in the average fish of various species, but very little information is available as to whether individual fish behave in a similar manner. Substantial between-subject variability reported in many of these experiments further clouds the issue. The major pressing concern, then, for behavioral toxicologists is to obtain reliable and precise measures and control over the behavior of individual fish for extended periods of time. Such control would provide behavioral toxicologists with a very sensitive yardstick against which to measure both the transient and long-term effects of most chemical pollutants. Once such information is obtained, ecologists and environmentalists will be able to objectively determine acceptable pollution levels, i.e., levels that will minimize the possibility of economic hardship and maximize that of fish survival. (Deal-EIS)

W79-05100

# EFFECT OF THERMAL INCREASES OF SHORT DURATION ON SURVIVAL OF EU- PAUSIA PACIFICA,

National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.

D. R. Craddock.

Fishery Bulletin, Vol. 76, No. 4, p. 895-900, 1979. 2 fig, 1 tab, 7 ref.

Descriptors: \*Water temperature, \*Heat resistance, Entrainment, \*Zooplankton, Fish food organisms, Cooling waters, Intakes, Mortality, Thermal powerplants, Thermal pollution, Seasonal, Distribution patterns, \*Euphausiids, \*Euphausia, Acclimation.

Thermal conditions encountered in a cooling system were simulated to determine the temperature increases that *E. pacifica* could resist for short periods (15 and 30 min.). Data from this study indicate that even a short passage time through a condenser (15 min) at temperatures of 23-24C could kill from 11 to 53% of the euphausiids by thermal causes alone. The added loss due to abrasion, pressure, and toxic substances is unknown. To minimize damage to the euphausiid populations, condenser cooling system intakes should be located deep enough to take advantage of the coldest cooling water available to minimize temperatures in the system. A very deep intake (just below 100m) would probably minimize the entrainment of euphausiids. (Deal-EIS)

W79-05101

# EXTREME TEMPERATURE TOLERANCE OF PALAEMON SERRATUS (PENNANT): INFLU- ENCE OF SIZE AND ACCLIMATION) TOLER- ANCE AUX TEMPERATURES EXTREMES DE PALAEMON SERRATUS (PENNANT): INFLU- ENCE DE LA TAILLE ET DE L'ACCLIMATA- TION,

Ecole Pratique des Hautes Etudes, Paris (France). Lab. de Biochimie et Ecologie des Invertébrés Marins; and Centre d'Océanographie, Marseille (France). Station Marine d'Endoume.

P. Richard.

Journal of Experimental Marine Biology and Ecology, Vol. 35, p. 137-146, 1978. 2 fig, 1 tab, 24 ref.

Descriptors: \*Water temperature, \*Cold resistance, \*Heat resistance, Animal physiology, Animal metabolism, Size, Toxicity, Mortality, Seasonal, Migration, Animal behavior, Shrimp, Crustaceans, Commercial shellfish, Acclimation, Survival.

Prawns of different body sizes (from 2-6cm) acclimated at four different temperatures (13, 17, 21, and 25C), were tested for their tolerance of extreme high and low temperatures. Time-temperature curves based on 50% survival show an increase in low temperature tolerance and a decline in high temperature tolerance with increasing body size. The upper and lower lethal temperatures of the different size groups tested for each acclimation temperature are very similar, especially for extreme high temperatures. Acclimation has a much more pronounced effect than body size on tolerance of extreme temperatures. Prawns acclimated at low temperatures are more resistant to extremely low temperatures, while acclimation to high temperatures increases survival at extreme high temperatures. In some size groups for which acclimation temperature is very close to the limit no advantage is gained by acclimation. Acclimation at 21C appears to ensure the highest relative resistance of *P. serratus* to extreme high temperature. Seasonal distribution and migratory behaviour are discussed in relation to these results. It appears that these phenomena cannot be entirely explained by tolerance of extreme temperatures. (Deal-EIS)

W79-05102

# THE LAKE WASHINGTON ECOSYSTEM: THE PERSPECTIVE FROM THE FISH COMMUN- ITY PRODUCTION AND FORAGE BASE,

Washington Univ., Seattle. Coll. of Fisheries.

D. M. Eggers, H. W. Bartoo, M. A. Rickard, R. E. Nelson, and R. C. Wissman.

Journal of the Fisheries Research Board of Canada, Vol. 35, p. 1553-1571, 1978. 9 fig, 7 tab, 78 ref.

Descriptors: \*Food chains, \*Fish populations, \*Domestic wastes, Ecosystems, Eutrophication, Predation, Herbivores, Zooplankton, Sculpins, Mortality, Growth stages, Daphnia, Trophic level, Productivity, Detritus, Benthic fauna, Growth rates, Sockeye salmon, Perches, Yellow perch, \*Bottom feeders, \*Squawfish, \*Neomysis, Lake Washington, Washington.

In Lake Washington, fish production through detritus-based food chains is substantially greater than fish production through the grazing food chain. The lack of significant grazing by fish on the zooplankton is a consequence of both piscivore predation and conditions in the planktivore spawning environment. At low planktivore abundance, squawfish may switch to benthos feeding, exploiting the abundant prickly sculpin. At high planktivore abundance, squawfish feed more heavily on planktivores. Thus, even when reproductive success of planktivores is good, swamping of the squawfish population does not occur and compensatory mortality due to squawfish predation prevents planktivore abundance from increasing to the point where zooplankton resource depletion would occur. Benthic-littoral species are vulnerable to predation essentially only as larva and juveniles. They avoid predation by occupying littoral and epibenthic refugia. Recruitment to the adult population from these refugia may be sufficient to account for the greater rate of benthos exploitation by fish relative to the rate of zooplankton exploita-

tion by fish. Neomysis is an important component of the Lake Washington fish production, since potentially Neomysis is a regulating agent on the zooplankton, and reduction in Neomysis predation on zooplankton, due to decreasing abundance and a deeper vertical distribution, may be partly responsible for the recent reappearance of Daphnia. The response of the fish community to trophic changes in Lake Washington has been slight. No consistent trends in the growth of fish utilizing zooplankton were observed. (Deal-EIS)

W79-05103

# VIBRIO CHOLERA, VIBRIO PARAHAE- MOLYTICUS, AND OTHER VIBRIOS: OCCUR- RENCE AND DISTRIBUTION IN CHESA- PEAKE BAY,

Maryland Univ., College Park. Dept. of Microbiology.

R. R. Colwell, J. Kaper, and S. W. Joseph.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A054 681. Price code: A02 in paper copy, A01 in microfiche. Science, Vol. 198, 1977. p. 394-396, 1 fig, 1 tab, 24 ref.

Descriptors: \*Pathogenic bacteria, \*Public health, \*Chesapeake Bay, Enteric bacteria, Bacteria, Spatial distribution, Temporal distribution, Toxicity, Toxins, Epidemics, Human diseases, Water quality, Water analysis, Epidemiology, \*Vibrio.

*Vibrio cholerae* was isolated at several locations in Chesapeake Bay in fall 1976 and spring 1977. Strains induced fluid accumulation in rabbit ileal loops and related vibrios show a spatial and temporal distribution characteristic of *Vibrio* species in an estuary. The *Vibrio cholerae* strains isolated from Chesapeake Bay represent serotypes other than O-group 1 - that is, so-called non-agglutinable vibrios and are not recognized as a serious epidemic threat, although they have caused cholera-like diarrhea sporadically. (Deal-EIS)

W79-05104

# INFLUENCE OF DILUTION WATER ON THE TOXICITY OF KRAFT PULP AND PAPER MILL EFFLUENT, INCLUDING MECHA- NISMS OF EFFECT,

British Columbia Research Council, Vancouver. Div. of Applied Biology.

For primary bibliographic entry see Field 5A.

W79-05105

# TOXICITY OF COPPER TO CUTTHROAT TROUT (SALMO CLARK) UNDER DIFFER- ENT CONDITIONS OF ALKALINITY, PH, AND HARDNESS,

Maine Univ. at Farmington. Dept. of Chemistry.

For primary bibliographic entry see Field 5A.

W79-05107

# TROPHIC LEVEL ACCUMULATION OF HEAVY METALS IN A COAL ASH BASIN DRAINAGE SYSTEM,

Texas Univ. Health Science Center at Houston. School of Public Health.

For primary bibliographic entry see Field 5A.

W79-05108

# THE USE OF SPECIES ABUNDANCE ESTI- MATES IN MARINE BENTHIC STUDIES,

Maine Univ., Walpole. Ira C. Darling Center for Research, Teaching and Service.

For primary bibliographic entry see Field 5A.

W79-05109

# A BIOASSAY LABORATORY BOAT WITH COMPARISONS OF CENTRAL VS. BOAT LAB- ORATORY BIOASSAY EVALUATIONS,

Academy of Natural Sciences of Philadelphia, PA. Div. of Limnology and Ecology.

For primary bibliographic entry see Field 5A.

W79-05111



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

**METHODS FOR DETERMINING THE OXYGEN CONSUMPTION OF A FISH UNDER CONDITIONS OF AQUATIC SEMI-CONFINEMENT (METHODES DE DETERMINATION DE LA CONSOMMATION D'OXYGENE D'UN POISSON DANS LES CONDITIONS DU SEMI-CONFINEMENT AQUATIQUE).**  
Amiens Univ. (France). Lab. de Physiologie.  
For primary bibliographic entry see Field 5A.  
W79-05112

**MERCURY AND SELENIUM IN BLUE MARLIN, MAKAIRA NIGRICANS, FROM THE HAWAIIAN ISLANDS.**  
National Marine Fisheries Service, Honolulu, HI. Southwest Fisheries Center.  
C. D. Shultz, and B. M. Ito.  
Fishery Bulletin, Vol. 76, No. 4, p 872-879, 1979. 6 fig. 2 tab, 18 ref.

Descriptors: \*Mercury, \*Chemical analysis, Hawaiian Islands, Sport fish, Spectrophotometry, Heavy metals, Biochemistry, Proteins, Path of pollutants, Food chains, Animal metabolism, Fish physiology, \*Tuna, \*Blue marlin, \*Tissue analysis, \*Selenium, \*Organic mercury, \*Methylmercury, \*Bioaccumulation.

The presence of selenium in tuna, a principal food item of marlin, indicates that it should also be present in marlin from the Hawaiian Islands. For this report, nine tissues from blue marlin were analyzed for selenium, total mercury, and organic mercury. Average total mercury and selenium values were greatest in kidney (26.33 mg/kg Hg, 23.42 mg/kg Se) and least in blood (0.18 mg/kg Hg, 1.29 mg/kg Se) and gill (0.32 mg/kg Hg, 1.29 mg/kg Se). Average methyl mercury was highest in muscle (0.40 mg/kg) and lowest in blood (0.04 mg/kg) and gill (0.06 mg/kg). The percentage of organic to total mercury ranged from 1% in kidney to 27% in gonad. The molar ratio of mercury to selenium ranged from 0.06 in blood to 0.62 in muscle. The data clearly demonstrate that methyl mercury concentrations are low relative to total mercury in blue marlin. (Deal-EIS)  
W79-05113

**THE MESA PUGET SOUND PROJECT, SEATTLE, WASHINGTON, FISCAL YEAR 1977 - ANNUAL REPORT.**  
National Oceanic and Atmospheric Administration, Boulder, CO. Marine Ecosystems Analysis Program Office.  
NOAA/ERL Marine Ecosystems Analysis Program Report, November 1978. 21 p. 1 fig, 28 ref, 3 append.

Descriptors: \*Environmental effects, \*Ecosystems, \*Water quality, Water pollution effects, Resources development, Washington, Puget Sound(WA), Annual reports.

The Puget Sound Project is planned to develop an understanding of the environmental impact of human actions upon regional marine ecosystems and to predict the ecological consequences of these actions. Wastewater disposal and energy-related activities are significant in the region and are receiving special attention. Project planning currently is oriented towards critical contaminants introduced into the system by human activity. The project design concept is multidisciplinary ecosystem research. It emphasizes research efforts to increase knowledge of the kinds and degree of environmental impacts resulting from contaminant loading, the cause of these impacts, the dynamic processes influencing the fates and effects of contaminants, and the possible actions that would minimize or eliminate undesirable effects. (NOAA)  
W79-05115

**MESA NEW YORK LIGHT PROJECT ANNUAL REPORT FOR FISCAL YEAR 1977.**  
National Oceanic and Atmospheric Administration, Boulder, CO. Marine Ecosystems Analysis Program Office.  
For primary bibliographic entry see Field 5B.  
W79-05116

**GROUND-WATER POLLUTION--A STATUS REPORT.**  
Illinois State Geological Survey, Urbana.  
D. E. Lindorff.  
Ground Water, Vol. 17, No. 1, p 9-17, January-February 1979. 3 fig, 2 tab, 34 ref.

Descriptors: \*Groundwater, \*Water pollution, \*Hydrogeology, Regulation, Industrial wastes, Water supply, Water pollution control, Pollution abatement, Waste disposal, Landfills, Contamination impacts.

More than 170 case histories of subsurface contamination or pollution were studied to evaluate the effectiveness of remedial action in different geologic environments. The case studies indicated that the severity and extent of groundwater contamination is determined by (1) the hydrogeologic setting, (2) the nature of the contaminant, and (3) the effectiveness of regulatory action. Industrial wastes are the most common sources of groundwater contamination. The most serious incidents are those that pollute or threaten water supplies and those that cause a fire or explosion. Once groundwater is contaminated, remedial action is time consuming and expensive. Each incident must be handled as a separate problem. Although prompt action is essential to limit contamination and minimize remedial action, no strategies have been established for rapid response to contamination or pollution problems. Groundwater contamination will continue, but its impact can be reduced. The role of hydrogeologists in regulatory agencies should be strengthened to provide proper evaluation of potential sources of contamination and to aid in remedial action when groundwater is contaminated. Cooperative efforts to develop strategies will ensure proper handling of future emergencies. (Visocky-ISWS)  
W79-05120

**GROUND-WATER POLLUTION--AN IMMINENT DISASTER.**  
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.  
W. A. Pettyjohn.  
Ground Water, Vol. 17 No. 1, p 18-24, January-February 1979. 6 fig, 19 ref.

Descriptors: \*Groundwater, \*Water pollution, \*Ohio, \*New York, \*Oregon, Water pollution control, Industrial wastes, Landfills, Leachate, Hydrogeology, Water pollution sources, Toxins, Chemical, Waste disposal, Water supply, Pollution costs, Case studies.

The significance of groundwater pollution depends on perspective. To those individuals who are directly affected, it is an imminent disaster. Once contaminated, groundwater may remain in an unusable or even hazardous condition for decades or even centuries as illustrated by situations in central Ohio, New York, London, and many other places. All polluted water can be treated to make it potable, but the expense may far exceed the resources of the individual homeowner. (Visocky-ISWS)  
W79-05121

**TRANSPORTATION OF ADULT AMERICAN SHAD PAST DAMS ON THE CONNECTICUT RIVER, MASSACHUSETTS, 1973-76.**  
Fish & Wildlife Service, Hadley, MA.  
J. B. Layzer.  
The Progressive Fish Culturist, Vol. 41, No. 1, p 7-9, 1979, 3 tab, 6 ref.

Descriptors: \*Massachusetts, \*Shad, \*Holyoke Dam, \*Turners Falls Dam, \*Fish transport, Fish migration, Mortality, Anadromous fish, \*Differential mortality, Trucking, Alosa, Fish sex, Adult fish, Fish passages, Fishing gear, Female mortality.

Adult American shad (*Alosa sapidissima*) were obtained from the Holyoke Dam fish lift, Massachusetts, and transported 68 km by truck to the pool above the Turners Falls Dam. From 1973 to 1976, 6373 shad were transported; average annual mortality was 25%. Mortality of trucked fish was related to river temperature and the number of fish

transported at any one time. During trucking a differential mortality occurred between sexes: 2.4 times more females died than males. (Katz-EIS)  
W79-05174

**EFFECT OF PHENOL UPON ACTIVATION AND FERTILIZATION ABILITY OF RAINBOW TROUT SPERMATOZOA (SALMO GAIARDNERI RICH.) (IN POLISH).**  
Institute of Ichthyology, Szczecin (Poland).  
L. Tomasiak, and K. Radziun.  
Zeszyty Naukowe Akademii Rolniczej W Szczecinie, Vol. 63, p 25-30, 1977. 2 tab, 6 ref, English Summary.

Descriptors: \*Phenols, \*Fish reproduction, \*Fish eggs, \*Rainbow trout, Toxicity, Fertility, Embryonic growth stage, Chemical analysis, Cytological studies, Inhibition, Resistance, Absorption, Bioassay, Laboratory tests, \*Spermatozoa.

Phenol aqueous concentrations ranging from 25 to 1500 mg/l were tested with regard to the spermatozoa activation and fertilization of *Salmo gairdneri* Rich. eggs. Concentrations up to 800 mg/l proved to exert no adverse effects upon the spermatozoa activation. However, the period of oscillatory movements is shortened with phenol concentrations from 500 mg/l upwards. Concentrations up to 500 mg/l show no detrimental effects upon percentage of fertilized eggs. Following a further increase in the phenol concentration the fertilization is observed to be strongly retarded up to a complete cessation of the process at 1300 mg/l. Considering known data on the phenol resistance of embryos, newly hatched young, and adult individuals, gametes are found to be the most resistant. (Deal-EIS)  
W79-05176

**EFFECT OF DBS DETERGENT ON ACTIVITY OF SOME ENZYMES OF YOUNG CARP (CYPRINUS CARPIO L.) BRAIN, GILLS AND SERUM.**  
Medical Academy, Gdansk (Poland). Inst. of Medical Biology.  
M. K. Jurkowski.  
Acta Ichthyologica et Piscatoria, Vol. 7, No. 2, p 47-53, 1977. 3 fig, 2 tab, 13 ref.

Descriptors: \*Detergents, \*Sulfonates, \*Enzymes, \*Carp, Toxicity, Biochemistry, Proteins, Chemical analysis, Path of pollutants, Fish physiology, Animal metabolism, Biological membranes, Organic compounds, \*DBS, \*Tissue analysis, \*ATP.

Effects of DBS (sodium dodecyl-benzene-sulphonate) on the activity of ATP-ases and cholinesterases of autumn young carp brain, gills, and serum were studied. On the second day of exposure the brain ATP-ases activity was found to increase by about 120%. On the twelfth day, the activity of these enzymes dropped by about 30% as compared to the control. Blood serum cholinesterases exhibited a constant increase in their activity throughout the experimental period. (Deal-EIS)  
W79-05177

**FINGERLING AMERICAN SHAD: EFFECT OF VALIUM, MS-222, AND SODIUM CHLORIDE ON HANDLING MORTALITY.**  
Georgia Univ., Savannah. Coastal Plain Station.  
For primary bibliographic entry see Field 5B.  
W79-05179

**PALAEMONID SHRIMP, MACROBRACHIUM AMAZONICUM: EFFECTS OF SALINITY AND TEMPERATURE ON SURVIVAL.**  
Texas Parks and Wildlife Dept., Ingram. Heart of Hills Fisheries Research Station.  
For primary bibliographic entry see Field 5B.  
W79-05181

**CHANGES IN THE SPECIES COMPOSITION OF FISH IN THE RIVER LOT.**  
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.  
For primary bibliographic entry see Field 5B.



## Effects Of Pollution—Group 5C

W79-05184

**ATLANTIC SALMON EMBRYOS AND FRY: EFFECTS OF VARIOUS INCUBATION AND REARING METHODS ON HATCHERY SURVIVAL AND GROWTH.**  
Bureau of Sport Fisheries and Wildlife, Cortland, NY. Tunison Lab. of Fish Nutrition.  
K. A. Leon, and W. A. Bonney.  
The Progressive Fish Culturist, Vol. 41, No. 1, p 20-25, 1979. 3 tab, 3 fig, 6 ref.

Descriptors: \*Methodology, \*Aquaculture, Laboratory tests, \*Laboratory equipment, Freshwater fish, \*Atlantic Salmon, Fish hatcheries, Fish eggs, Juvenile fish, Incubation methods, Rearing methods, Water quality, Hatchery survival, Hatchery growth.

Significantly heavier fry of Atlantic salmon (*Salmo salar*) and greatly reduced mortality apparently resulted from the use of matrix substrates during egg incubation and alevin development. Salmon fry produced by this method fed readily and did not have the constricted yolk sacs that commonly occur when conventional rearing methods are used. (Katz-EIS)

W79-05187

**THE ECOLOGICAL IMPACT ON AND NEAR SHORES BY THE AMOCO CADIZ OIL SPILL.**  
Universite de Bretagne-Occidentale, Brest (France). Inst. d'Etudes Marine.  
For primary bibliographic entry see Field 5B.  
W79-05190

**SURVIVAL OF SALMON SMOLTS IN SEA WATER AFTER EXPOSURE TO AIR-SUPER-SATURATED WATER.**  
Corvallis Environmental Protection Agency, OR. Western Fish Toxicology Station.  
For primary bibliographic entry see Field 5B.  
W79-05191

**BIRDS OILED DURING THE AMOCO CADIZ INCIDENT - AN INTERIM REPORT.**  
Royal Society for the Protection of Birds Sandy (England).  
For primary bibliographic entry see Field 5B.  
W79-05192

**NOTES ON THE CONDITION IN SEPTEMBER 1978 OF SOME INTERTIDAL SANDS POLLUTED BY AMOCO CADIZ OIL.**  
Marine Biological Association of the United Kingdom, Plymouth (England). Plymouth Lab.  
For primary bibliographic entry see Field 5B.  
W79-05193

**PRELIMINARY OBSERVATIONS ON POLLUTION OF THE SEA BED AND DISTURBANCE OF SUB-LITTORAL COMMUNITIES IN NORTHERN BRITANNY BY OIL FROM THE AMOCO CADIZ.**  
Station Biologique de Roscoff (France).  
For primary bibliographic entry see Field 5B.  
W79-05194

**THE AMOCO CADIZ OIL SPILL. A SUMMARY OF OBSERVATIONS MADE BY U.S. SCIENTISTS 23 MARCH-10 MAY, 1978.**  
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs. D. A. Wolfe.  
Marine Pollution Bulletin, Vol. 9, No. 11, p 288-292, 1978. 6 fig, 3 ref.

Descriptors: \*Oil, \*Oil spills, \*Amoco Cadiz, \*Water pollution effects, Littoral, Beaches, Sediments, Seawater, \*On-site investigations, NOAA/EPA Report, Wind/Wave/Oil interactions, Currents(Water), Ocean currents, Ocean waves, Beach processes, Oiled sands, Waste treatment, Clean-up activities, Marine algae, Gas chromatography.

This paper summarizes briefly the observations made by a team of United States scientists during the two months immediately after the grounding of the Amoco Cadiz. Most of the information has been abstracted from the NOAA/EPA preliminary scientific report (Hess, 1978) which provides a more complete account of objectives and results to date. It is hoped that maximum use may be derived from a study of the effects of the spill. Oceanographic and meteorologic processes, beach processes, clean up activities and chemical observations are reported. (Katz-EIS)  
W79-05195

**TOXICITY OF RESIDUAL CHLORINE COMPOUNDS TO AQUATIC ORGANISMS.**  
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.  
For primary bibliographic entry see Field 5B.  
W79-05197

**PREDICTING NIGHTTIME DISSOLVED OXYGEN DECLINE IN PONDS USED FOR TILAPIA CULTURE.**  
Alabama Univ., Auburn. Dept. of Fisheries and Allied Aquacultures.  
For primary bibliographic entry see Field 5B.  
W79-05200

**EVALUATION OF PH SHOCK ON HATCHERY-REARED RAINBOW TROUT.**  
Arizona Cooperative Fishery Unit, Tucson.  
W. A. Witschi, and C. D. Ziebell.  
The Progressive Fish Culturist, Vol. 41, No. 1, p 3-5, 1979. 1 tab, 1 fig, 4 ref.

Descriptors: \*Bioassay, \*Mortality, Toxicity, \*Hydrogen ion concentration, Rainbow trout, \*Aquaculture, Fish hatchery, Hatchery-reared trout, pH shock, Fish management, Fish physiology, Arizona.

The effect of transferring hatchery-reared rainbow trout from water with a pH of 7.2 to water with pH's ranging from 8.5 to 10.0 was evaluated in 48-h tests. All fish survived in the control (pH 7.2) and at pH 8.5. Survival was 88% at pH 9.0, 68% at pH 9.5, and 0 at pH 10.0. After the 48-h exposure, the remaining test fish were fed their usual pelleted food. Trout in the control and those held at pH 8.5 fed well. Only a few of the fish held at pH 9.0, and none of those held at pH 9.5, fed. These data indicate that it is not advisable to stock rainbow trout reared in nearly neutral hatchery water into lakes with a pH of 9.0 or higher. (Katz-EIS)  
W79-05202

**EFFECTS OF CONTINUOUS ZINC EXPOSURE ON SOCKEYE SALMON DURING ADULT-TO-SMOLT FRESHWATER RESIDENCY.**  
Corvallis Environmental Research Lab., OR. Western Fish Toxicology Station.  
G. A. Chapman.  
Transactions of the American Fisheries Society, Vol. 107, No. 6, p 828-836. 1978. 4 fig, 3 tab, 16 ref.

Descriptors: \*Zinc, \*Sockeye salmon, \*Toxicity, Water quality standards, Mortality, Lethal limit, Embryonic growth stage, Fertility, Recundity, Growth rates, Adaptation, Fish reproduction, Fish physiology, Chemical analysis, Heavy metals, Life history studies, \*Survival.

This chronic zinc toxicity test with sockeye salmon consisted of a 3-mo adult exposure followed by an 18-mo exposure of embryonic through smolt stages. The zinc concentrations utilized were 30 to 112 ug/liter concentration was used for the embryo-to-smolt exposure period. These zinc concentrations produced no adverse effects on survival, fertility, fecundity, growth, or on the subsequent survival of smolts transferred to seawater. Exposure to 242 ug/liter produced sufficient acclimation to markedly decrease acute mortality at zinc levels lethal to unacclimated sockeye salmon juveniles. The 112 and 242-ug/liter concentrations were 0.15 and 0.32, respectively, of the 749-ug/liter, 96-h LC50 for the 8-mo-old sockeye salmon.

An application factor relating 96-h LC50 and 'safe' concentrations of zinc to anadromous sockeye salmon in soft water appears to be  $> 0.15$  and at least 15 times larger than the often recommended 0.01 application factor for zinc based on studies with other species. (Katz-EIS)  
W79-05203

**EFFECTS OF ELEVATED TEMPERATURE ON EARLY EMBRYONIC DEVELOPMENT OF THE TAUTOGE, TAUTOGA ONITIS.**  
National Marine Fisheries Service, Highlands, NJ. Sandy Hook Lab.  
B. L. Olla, and C. Samet.  
Transaction of the American Fisheries Society, Vol. 107 No. 6, p 820-824. 1978. 1 tab, 23 ref.

Descriptors: \*Water temperature, \*Fish reproduction, \*Heat resistance, Embryonic growth stage, Animal pathology, Growth stages, Toxicity, Heated water, Spawning, Fish eggs, Mortality, Fish physiology, \*Tautoge, \*Tautoga, \*Teratogens, \*Tissue analysis.

The effect of elevated temperature on early embryonic development of tautog was the subject of a study in which both spawning adults and developing eggs were exposed to similar temperatures. When incubation temperature was gradually raised from 20.0°C, anatomical deformities, including stunted embryos and/or abnormal body curvatures, as well as increased mortality occurred between 24.2 and 26.3°C. Normal development was evident after the temperature returned to 20.0°C. (Deal-EIS)  
W79-05204

**THE RIOU-MORT A TRIBUTARY TO THE RIVER LOT POLLUTED BY HEAVY METALS. I. PRELIMINARY OBSERVATIONS ON THE CHEMISTRY AND BENTHIC ALGAE.**  
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.  
For primary bibliographic entry see Field 5B.  
W79-05206

**ACUTE TOXICITY OF PERMETHRIN TO SEVERAL AQUATIC ANIMALS.**  
Louisiana State Univ., Baton Rouge. Fisheries Div.  
A. L. Jolly Jr.  
Transactions of the American Fisheries Society, Vol. 107, No. 6, p 825-827. 1978. 1 tab, 13 ref.

Descriptors: \*Pesticide toxicity, \*Insecticides, \*Crayfish, \*Channel catfish, \*Bass, \*Frogs, Agricultural chemical, Toxicity, Pesticide residues, Livebearers, Commercial shellfish, Pesticide kinetics, Path of pollutants, \*Permethrin, \*Mosquitofish.

Acute toxicity tests were conducted on permethrin (Pounce(TRADEMARK)), a synthetic pyrethroid, by using 8-12- and 20-30-mm Louisiana red swamp crayfish (*Procambarus clarkii*), fry channel catfish (*Ictalurus punctatus*), fingerling largemouth bass (*Micropterus salmoides*), mosquitofish (*Gambusia affinis*), and bullfrog tadpoles (*Rana catesbeiana*). The 96-h LC50 values were 0.39, 0.62, 1.1, 8.5, 15.0, and 7.033 ug/liter, respectively. (Deal-EIS)  
W79-05207

**THE USE OF COPPEROXYCHLORIDE DURING LARVAL GROWTH AS A PREVENTATIVE MEASURE AGAINST THE SPREAD OF CILIATA-EXOPARASITES.**  
Warmwater Fish Hatchery (Hungary).  
For primary bibliographic entry see Field 5B.  
W79-05209

**A MERCURY BUFFER FOR TOXICITY EXPERIMENTS WITH GREEN ALGAE.**  
Technische Hogeschool, Delft (Netherlands). Lab. of General and Technical Biology.  
For primary bibliographic entry see Field 5A.  
W79-05210

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

#### ASSESSMENT OF POTENTIAL INTERACTIONS OF MICROORGANISMS AND POLLUTANTS RESULTING FROM PETROLEUM DEVELOPMENT

Louisville Univ., KY. Dept. of Biology.  
R. M. Atlas.

In: 'Environmental Assessment of the Alaskan Continental Shelf,' Quarterly Reports of Principal Investigators for April - June 1978, U.S. Department of Commerce Environmental Research Laboratories, Boulder, Colo. September 1978. p 40-49, 2 tab. 03-5-022-85.

Descriptors: \*Biodegradation, \*Oil spills, \*Environmental effects, \*Baseline studies, Resource development, Data collections, Microorganisms, Alaska, \*Outer Continental Shelf, Petroleum hydrocarbons.

Samples were collected for microbiological studies in Lower Cook Inlet during April - May. Sediment-oil trays in Elson Lagoon were sampled during April. Under ice-oil cylinders were also recovered during April. Miniature oil spills were released under ice in April to develop prototypes for future oil under ice degradation experiments. The movement of the oil under the ice was filmed. Laboratory testing for taxonomic analyses of microbial isolates from the November Cook Inlet cruise has been completed. (Sinha-OEIS)  
W79-05212

#### COASTAL MORPHOLOGY, OIL SPILL VULNERABILITY AND SEDIMENTOLOGY OF KOTZEBUE SOUND AND KODIAK ISLAND, SOUTH CAROLINA UNIV., COLUMBIA. DEPT. OF GEOLOGY.

M. O. Hayes, and C. H. Ruby.  
In: 'Environmental Assessment of the Alaskan Continental Shelf,' Quarterly Reports of Principal Investigators for April - June 1978, U.S. Department of Commerce, Environmental Research Laboratories, Boulder, Colo. September 1978. p 50-53.

Descriptors: \*Oil spills, \*Sedimentology, \*Environmental effects, Coasts, Resources development, Alaska, \*Outer Continental Shelf, Coastal morphology.

The major emphasis of this project is to: evaluate present rates of change in coastal morphology, with particular emphasis on rates and patterns of man-induced changes, and locate areas where coastal morphology is likely to be changed by man's activities, if any. The relative susceptibility of different coastal areas will be evaluated especially with regard to potential oil spill impacts. (Sinha-OEIS)  
W79-05213

#### THE EFFECTS OF OIL ON TEMPERATURE REGULATION IN SEA OTTERS

Scripps Institution of Oceanography, La Jolla, CA. Physiological Research Lab.

G. Kooyman, and D. Costa.  
In: 'Environmental Assessment of the Alaskan Continental Shelf,' Quarterly Reports of Principal Investigators for April - June 1978, U.S. Department of Commerce, Environmental Research Laboratories, Boulder, Colorado September 1978. p 66-69.

Descriptors: \*Oil pollution, \*Water pollution effects, \*Otters, \*Baseline studies, Temperature, Metabolism, Resources development, Alaska, \*Outer Continental Shelf.

A significant amount of time has been spent preparing for the expedition to Prince William Sound, AK in July 1978. The objectives are to study: (1) energy requirements of normal sea otters at various water temperatures; (2) energy requirements of sea otters after oiling; (3) appropriate procedures for rehabilitating oiled sea otters; and (4) a sea behavior and energetics of sea otters. These objectives will provide a data base from which the assessment of any kind of oil contamination, or other activity which may alter the nature of the otter's food sources can be derived. In addition, relative to oil contamination the difficulties and costs of rehabili-

tating the oiled otters can be estimated. (Sinha-OEIS)  
W79-05214

#### ACUTE AND CHRONIC TOXICITY, UPTAKE AND DEPURATION, AND SUBLETHAL METABOLIC RESPONSE OF ALASKAN MARINE ORGANISMS TO PETROLEUM HYDROCARBONS

National Marine Fisheries Service, Auke Bay, AK. Northwest and Alaska Fisheries Center.

S. D. Rice, J. F. Karinen, and S. Korn.  
Un: 'Environmental Assessment of the Alaskan Continental Shelf,' Quarterly Reports of Principal Investigators for April - June 1978, U.S. Department of Commerce, Environmental Research Laboratories, Boulder, Colorado, p 70-79, September 1978.

Descriptors: \*Oil pollution, \*Water pollution effects, \*Toxicity, \*Salinity, Resources development, Environmental effects, Fish Shellfish, Alaska, \*Outer Continental Shelf, \*Aromatic hydrocarbons, Petroleum hydrocarbons.

New experiments were started in the April-June quarter and a study to determine effects of salinity on oil toxicity to several species was almost completed. Data collecting and experiments are on schedule, while data analysis, work-up, report writing, manuscript synthesis, etc. are progressing slowly. A major breakthrough occurred with the development of a new system to maintain stable concentrations of aromatic hydrocarbons in water. The system, which injects dissolved aromatics, can be used with any number of aromatics simultaneously. This will allow synthetic WSF tests and continuous-flow isotope uptake studies. (Sinha-OEIS)  
W79-05215

#### SUBLETHAL EFFECTS OF PETROLEUM HYDROCARBONS AND TRACE METALS, INCLUDING BIOTRANSFORMATIONS, AS REFLECTED BY MORPHOLOGICAL, CHEMICAL, PHYSIOLOGICAL, PATHOLOGICAL AND BEHAVIORAL INDICES

National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.

D. C. Malins, E. H. Gruger, Jr., H. O. Hodgins, N. L. Karrick, and D. D. Weber.  
In: 'Environmental Assessment of the Alaskan Continental Shelf,' Quarterly Reports of Principal Investigators for April - June 1978, U.S. Department of Commerce, Environmental Research Laboratories, Boulder, Colorado, September 1978, p 82-99. 1 tab, 29 ref.

Descriptors: \*Oil pollution, \*Water pollution effects, \*Environmental effects, Metals, Fish, Shellfish, Biology, Alaska, \*Outer Continental Shelf, \*Petroleum, hydrocarbons, Sublethal effects, Biotransformations.

The response of marine organisms to environmental contaminants are reflected in numerous changes that are detectable at population and organismic levels, as well as at cellular and molecular levels. The general scope of this study is to evaluate effects caused by behavioral, physiological, pathological, morphological, and chemical changes in subarctic and arctic marine animals exposed to petroleum hydrocarbons and trace metals. (Sinha-OEIS)  
W79-05216

#### THE INTERACTION OF OIL WITH SEA ICE

Washington University, Seattle. Dept. of Oceanography.

S. Martin.  
In: 'Environmental Assessment of the Alaskan Continental Shelf,' Quarterly Reports of Principal Investigators for April - June 1978, U.S. Department of Commerce, Environmental Research Laboratories, Boulder, Colorado, September 1978, p 112-118. 3 fig.

Descriptors: \*Oil pollution, \*Water pollution effects, \*Sea ice, \*Oil spills, Resources development,

Environmental effects, Baseline studies, Alaska, \*Outer Continental Shelf, Pack ice, Petroleum.

A series of experiments on the interaction of pollutants and grease ice were carried out. It was found that when waves propagate into grease ice, that because of the non-linear viscosity of grease ice, the wave amplitude decays linearly, with the grease ice nature undergoing a transition from a liquid to a solid as the waves' amplitude becomes small. On one side of this transition, the waves propagate as water waves; on the other, they propagate as elastic waves. When oil is released into this wave-agitated ice, it accumulates at the liquid-solid transition. (Sinha-OEIS)  
W79-05217

#### TRANSPORT MECHANISMS AND HYDROCARBON ADSORPTION PROPERTIES OF SUSPENDED MATTER IN LOWER COOK INLET

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.

R. A. Feely, and G. J. Massoth.

In: 'Environmental Assessment of the Alaskan Continental Shelf,' Quarterly Reports of Principal Investigators for April - June 1978, U.S. Department of Commerce, Environmental Research Laboratories, Boulder, Colorado, p 164-169, September 1978. 1 fig.

Descriptors: \*Oil pollution, \*Sediment transport, \*Water pollution effects, Suspended solids, Resources development, Alaska, \*Outer Continental Shelf, Hydrocarbons, Lower Cook Inlet.

The major objectives of the Lower Cook Inlet suspended matter program include: (1) determination of the seasonal variability of the vertical fluxes, the distribution, and the composition of suspended particulate matter in areas of contrasting sedimentation and productivity; (2) participation in an interdisciplinary study of the partitioning of several trace element species among their major reservoirs; and (3) investigation of the physical processes and mechanisms controlling the accommodation of petroleum hydrocarbons with respect to Lower Cook Inlet suspended matter. (Sinha-OEIS)  
W79-05218

#### DISTRIBUTION AND DYNAMICS OF HEAVY METALS IN ALASKAN SHELF ENVIRONMENTS SUBJECT TO OIL DEVELOPMENT, ALASKA UNIV., FAIRBANKS. INST. OF MARINE SCIENCE.

D. C. Burrell.

In: 'Environmental Assessment of the Alaskan Continental Shelf,' Quarterly Reports of Principal Investigators for April - June 1978, U.S. Department of Commerce, Environmental Research Laboratories, Boulder, Colorado, p 170-200, September 1978. 16 fig, 6 tab. 03-5-022-56.

Descriptors: \*Oil pollution, \*Heavy metals, \*Toxicity, \*Water pollution effects, Resources development, Biota, Sediments, Environmental effects, Baseline studies, Alaska, \*Outer continental Shelf.

Natural pathways of potentially toxic heavy metals to and through Alaskan Shelf and coastal marine biota (with emphasis on commercially important benthic species) are researched to determine and predict changes likely to result from oil industry activity in this marine zone. Ancillary components of this work include: (1) characterizing the heavy metal inventories of the water, sediment and indigenous biota in those geographic areas for which no background data exist; (2) determining non-biological pathways (rates and routes under both natural and stressed conditions) of the heavy metals to these affect the availability of metals to the organisms; and (3) toxicity effects of selected heavy metals to animals which are of major commercial importance under Alaskan environmental conditions. (Sinha-OEIS)  
W79-05219



## Effects Of Pollution—Group 5C

# STUDY OF MICROBIAL ACTIVITY AND CRUDE OIL-MICROBIAL INTERACTIONS IN THE WATERS AND SEDIMENTS OF COOK INLET AND THE BEAUFORT SEA.

Oregon State Univ., Corvallis. Dept. of Microbiology.  
R. F. Griffiths, and R. Y. Morita.  
In: 'Environmental Assessment of the Alaskan Continental Shelf,' Quarterly Reports of Principal Investigators for April - June 1978, U.S. Department of Commerce, Environmental Research Laboratories, Boulder, Colorado, p 204-246, September 1978. 7 fig, 18 tab. 03-5-022-68.

Descriptors: \*Oil pollution, \*Water pollution effects, Microorganisms, Sediments, Environmental effects, Alaska, \*Outer Continental Shelf, Beaufort Sea.

Studies of relative microbial activity and respiration (mineralization) ratios of natural microbial populations found in water and sediment samples are continued. Areas which are shown to have particularly high activity should be those in which crude oil will be degraded at higher rates. These areas probably support the highest overall biological activity and as such may be the areas which will be most affected by the presence of crude oil. These data may also be used in the future to estimate the degree of perturbation caused by chronic crude oil input. The studies include crude oil effects on microbial function as measured by uptake and respiration characteristics using several labeled compounds. They also include the study of nitrogen fixation and the effects of crude oil on this process. (Sinha-OEIS)  
W79-05220

# INFLUENCE OF PETROLEUM ON EGG FORMATION AND EMBRYONIC DEVELOPMENT IN SEABIRDS.

Point Reyes Bird Observatory, Stinson Beach, CA. D. G. Ainley, C. R. Grau, and S. H. Morrell.  
In: 'Environmental Assessment of the Alaskan Continental Shelf,' Quarterly Reports of Principal Investigators for April - June 1978, U.S. Department of Commerce, Environmental Research Laboratories, Boulder, CO, p 552-557, September 1978.

Descriptors: \*Oil pollution, \*Water pollution effects, \*Birds, \*Embryonic growth stage, Baseline studies, Environmental effects, Resources development, Alaska, Testing, \*Outer Continental Shelf, Petroleum.

The most fundamental and significant observation from this quarter's work is that egg laying in Cassin's auklets is not eliminated by ingestion of 1 gram of either Prudhoe Bay crude oil or Bunker C oil. This, however, may have little influence on eventual reproductive success in oiled seabirds if oil ingestion with a meal during egg formation causes eggs not to hatch. Apparently oil ingestion by a bird during yolk formation causes changes in the yolk which can be identified by chemical and physical methods. Eggs from ducks fed 4 different crude oils were all identified as eggs from birds which had ingested oil by examining spots of extracts of yolk on thin layer plate under UV light. UV spectrophotometric scans of similar but more purified extracts shows a shoulder at 258 nm. These data indicate that fluorescent, UV absorbent compounds are present in yolks of birds fed oil. Levy (1970) has stated that absorbance at 256 nm should be considered evidence of the presence of petroleum compounds. If this is true it appears likely that the UV absorbing fluorescent compound(s) found in oil yolks are of oil origin and not biogenic or induced compounds found after oil ingestion. (Sinha - OEIS)  
W79-05221

RESEARCH TO DETERMINE THE ACCUMULATION OF ORGANIC CONSTITUENTS AND HEAVY METALS FROM PETROLEUM-IMPACTED SEDIMENTS BY MARINE DETRITIVORES OF THE ALASKAN CONTINENTAL SHELF,  
Battelle Pacific Northwest Labs., Sequim, WA.

Marine Research Lab.

J. S. Anderson, J. M. Augenfied, E. A. Crecelius, and R. Riley.

21 'Environmental Assessment of the Alaskan Continental Shelf,' Quarterly Reports of Principal Investigators for April - June 1978, U.S. Department of Commerce, Environmental Research Laboratories, Boulder, Colorado, September 1978, p 581-596. 1 fig, 5 tab, 7 ref. No. 231102778.

Descriptors: \*Oil pollution, \*Water pollution effects, \*Sediments, Heavy metals, Biota, Alaska, Testing, Resource development, \*Outer Continental shelf, Detritivores.

An experiment was conducted to determine the fate of specific hydrocarbons in oil-impacted sediments, in terms of their distribution in association with sediment particles, in interstitial and surface water, and in detritivorous organisms, as well as their chemical alteration into polar metabolites. For this purpose, 190 Macoma inquinata, a detritus-feeding clam, and 100 kg sediment were collected from the low intertidal zone in an area of coarse sand mixed with fine gravel. The results summarized in tabular form indicate that the solubility of heavier hydrocarbons in interstitial water is inversely related to their molecular weight. The interstitial concentration of phenanthrene rises to a peak after 15 days at a level equivalent to 7.2% of the initial measured sediment concentration. In later measurements it declined to about one third of this value. The concentration in the surface water overlying the sediment was an order of magnitude less than that in the interstitial water, but it increased and decreased in step with the latter. (Sinha - OEIS)  
W79-05222

# ACTIVITY-DIRECTED FRACTIONATION OF PETROLEUM SAMPLES,

Battelle Columbus Labs., OH.

J. S. Warner, and J. W. Anderson.

In: 'Environmental Assessment of the Alaskan Continental Shelf,' Quarterly Reports of Principal Investigators for April - June 1978, U.S. Department of Commerce, Environmental Research Laboratories, Boulder, CO, 2 tab, p 642-651, September 1978.

Descriptors: \*Oil pollution, \*Water pollution effects, \*Toxicity, Weathering, Biota, Environmental effects, \*Outer Continental shelf, \*Weathered oil, Crude oil, Mutagenicity.

This research program is an effort to determine the potential environmental hazard of the nonhydrocarbon portions of weathered oil. The program involves fractionation of both fresh and weathered Prudhoe Bay crude oil, subfractionation of primarily nonhydrocarbon fractions, biological screening of fractions to assess their toxicity and mutagenicity, and chemical characterization of any highly active fractions. Solvent studies have indicated that cyclopentanone and cyclopentanol are solvents of choice for completely dissolving crude oil and permitting it to be dispersed in water with a minimum of toxicity contributed by the solvent. The Ames mutagenicity assay, prescreen confluency assay for mammalian cell toxicity, and in vivo bioassays using brine shrimp and mysids were used to screen cyclopentanone solutions of reference compounds, crude oil, and crude oil fractions. Although the reference compounds were active, the design of the assays to accommodate highly involatile components prevented much biological activity from crude oil and its fractions. (Sinha - OEIS)  
W79-05223

# THE TRANSPORT AND BEHAVIOR OF OIL SPILLED IN AND UNDER SEA ICE,

Flow Research Co., Kent, WA.

M. D. Coon, and R. S. Pritchard.

In: 'Environmental Assessment of the Alaskan Continental Shelf,' Quarterly Reports of Principal Investigators for April - June 1978, U.S. Department of Commerce, Environmental Research Laboratories, Boulder, CO, p 777-779, September 1978.

Descriptors: \*Oil spills, \*Oil pollution, \*Sea ice, \*Water pollution effects, Resources development, Environmental effects, Alaska, \*Outer Continental Shelf.

The goal of the proposed work is to determine the locations to which oil spilled in or under the ice cover near Prudhoe Bay, Alaska, would be transported and to determine the behavior of the oil as the ice cover moves and deforms. Two separate tasks are identified. First, to determine a range of velocity fields which might be taken by the ice cover on the continental shelves of the Beaufort and Chukchi Seas by numerical modeling and synthesis of the results with manned and drifting station data. These velocity fields shall represent the climatological mean (or most probable) and extremes. As part of this task major breakouts of the ice from the Chukchi into the northern Bering Sea shall be considered. The second task is for the overall management of the program as well as possible to determine the likely trajectory and destination points for oil in several hypothetical scenarios by combining the relevant information obtained. (Sinha - OEIS)  
W79-05224

# AN ANNUAL PHYTOPLANKTON STUDY IN COASTAL WATERS OFF EASTERN LONG ISLAND (BLOCK ISLAND SOUND),

New York Ocean Science Lab., Montauk.

R. D. Staker, and S. F. Bruno.

Botanica Marina, Vol. 21, No. 7, p 439-449, October 1978. 6 fig, 4 tab, 19 ref.

Descriptors: \*Phytoplankton, \*Block Island Sound (New York), \*Ecology, \*Cycles, \*Dominant organisms, \*Species composition, Diatoms, Skeletonema costatum, Thalassiosira nordenskiöldii, Ceratium tripos, Chrysophyta, Pyrrophyta, New York, Long Island (NY), Annual algae, Coasts, Atlantic Ocean, Oceans, Nutrients, Limiting factors, Nitrates, Phosphorus, Dissolved oxygen, Abundance, Species diversity, Biomass, Floral lists.

Ninety-three bacillariophyceae species and 25 phyrophyta species were identified in a survey of planktonic algae in neritic waters of Block Island Sound off eastern Long Island, New York. Skeletonema costatum had the highest cell count but was surpassed by Thalassiosira nordenskiöldii and Ceratium tripos in biomass. Water was sampled semimonthly October 1975-November 1976; seawater temperature ranged 1-22°C, salinity 27.7-31.7‰, and pH averaged 7.83. Oxygen readings were usually greater than 5.0 ml/l (mean 5.91 ml/l), and average vitamin B12 levels were similar to other coastal waters (mean 1.83 ng/l; maximum 10.6 ng/l). While phosphorus levels appeared satisfactory for phytoplankton growth (reactive phosphorus levels never fell below 0.1 micrograms/liter), nitrate-nitrogen values may have been close to limiting from late May to early July. Most nitrate-nitrogen levels fell drastically mid-January to mid-February, while phytoplankton reached a peak between mid-January and mid-March, contrary to conditions observed in eastern Long Island Sound. The dominance among diatoms of S. costatum during bloom periods agrees with previous studies in Long Island and Block Island Sounds, but its relative importance appeared to be less in the present study. A complete species list is given and species diversity was calculated by the Shannon Index. (Lynch-Wisconsin)  
W79-05231

# KANSAS RIVER LIMNOLOGY: SEASONAL VARIATIONS IN PHOTOSYNTHETIC PRODUCTION AND HEAVY METAL ACCUMULATION BY AQUATIC INSECTS,

Kansas Water Resources Research Inst., Manhattan.

G. R. Marzolf.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 604. Price codes: A04 in paper copy, A01 in microfiche. Contribution No 207, Project Completion Report, January 1979. 56 p, 4 fig, 2 tab, 20 ref. OWRIT A-078-KAN(1). 14-34-0001-7035.



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

Descriptors: \*Aquatic insects, \*Heavy metals, \*Primary production, Plankton, Algae, Eutrophication, Photosynthesis.

Maximum photosynthetic production in the Kansas River is estimated at 30 gm C m<sup>-2</sup> day<sup>-1</sup>. This rate is extraordinarily high, exceeding the maximum integral values for the most eutrophic lakes in the world by six fold. The maximum rate of production by the planktonic component is 3 times higher than the most eutrophic lakes at approximately 15 gm C m<sup>-2</sup> day<sup>-1</sup>. The total community production estimate carries with it the potential for error associated with the diffusion estimate, but the error affects precision not accuracy and the planktonic production estimate does not contain this error. The analysis of diel oxygen curves from the open stream to evaluate photosynthetic production involves the estimation of reaeration coefficients. As a practical matter this has been a difficult estimation to make. The measurement of planktonic algal activity can be done in enclosures which preclude the need for a diffusion correction, and since the river is well mixed by turbulent flow the associated sampling errors are low and easily evaluated. The concentration of metals in aquatic insects is quantifiable with X-ray fluorescence instrumentation. The sampling error is too great to discern differences in metal concentrations between times of the year or between stations on the river. There are, however, clear differences between insect species. W79-05234

#### NON-POINT WATER QUALITY MODELING IN WILDLAND MANAGEMENT: A STATE-OF-THE-ART ASSESSMENT. (VOLUME I. TEXT).

Forest Service, Washington, DC.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-269 280, Price codes: A08 in paper copy, A01 in microfiche. Final Report. Prepared for Environmental Research Lab, Athens, Georgia, April 1977. 145 p, 2 fig, 14 tab, 360 ref.

Descriptors: \*Forestry, \*Water quality, \*Model studies, \*Wildland management, \*Nonpoint pollution, \*Simulation analysis, Runoff, Hydrology, Erosion, Planning, Watershed studies, Evaluation, Methodology, Inventories, Prediction, Systems analysis, Effects.

Predicting nonpoint pollution from wildland environments is evaluated in three main areas: management activity/pollutant relationship; predictive model review and state-of-the-art assessment; and an inventory of 176 wildland watersheds suitable for model validation and development. Nonpoint pollution is directly related to the time and space variability of the hydrologic cycle and existing terrain, and the relationship is site-dependent. Impact of sedimentation from site disturbance is the most common. Predictive models for nonpoint pollutant loading relating spatial variability and diversity of terrain to management activities are the most important in evaluating the potential on-site impact of planned wildland management activities. Few nonpoint loading models exist. The state-of-the-art is represented by process simulation models, not yet extensively used for field application. Their use will require validation and simplification. Modular model development will have the maximum utility in the decision process. The state-of-the-art at the field level lags that of research and is represented by regional regression models and analytical procedures. Watersheds available for nonpoint model validation and testing do not have long data records (less than 10 years), except on streamflow and to a lesser extent suspended sediment. (See also W79-05270) (Bell-Graf-Cornell) W79-05269

#### ALGAE AND WATER POLLUTION, C. M. Palmer.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-287 128, Price codes: A07 in paper copy, A01 in microfiche. Report No. EPA-600/9-77-036, December 1977. 124 p, 73 fig, 24 tab, 283 ref. 1BC611. 68-03-0232.

Descriptors: \*Water quality control, \*Algae, \*Water pollution effects, \*Eutrophication, \*Manuals, \*Water pollution control, \*Identification keys, \*Algal control, Beneficial use, Identification, Odor-producing algae, Taste-producing algae, Filter-clogging algae, Streams, Lakes, Reservoirs, Floral lists, Cyanophyta, Chlorophyta, Diatoms, Chrysophyta, Sewage lagoons, Stabilization ponds, Toxicity, Phytoplankton, Sessile algae, Bioindicators, Methodology, Estuaries, Bibliographies.

An updated enlargement of a 1959 manual gives greater emphasis to algae associated with water pollution. New chapters include algae in streams, algae and eutrophication, algae and estuarine pollution, algae as water quality indicators, and algae in sewage stabilization ponds. New material was added to original chapters which deal with the significance and ecology of algae, algal identification, algae in lakes and reservoirs, attached algae, clean-water algae, algae and freshwater pollution, taste and odor algae, filter and screen-clogging algae, other problems caused by algae (slime, coloration, toxicity, parasites, radioactivity), additional uses for algae (in industry, food for fish, waste treatment, marine pollution indicators, indicators of temperature, pH, and toxicity), algal enumeration procedures, and algal control. The revised identification key contains many additional species, and the most important are illustrated in color plates. Most chapters include a selected bibliography and list of typical algae for the situation under discussion, and an extensive bibliography is appended to the manual. The manual is intended for use by staff of water or wastewater treatment plants, to assist them in diagnosing and remedying problems caused by algae, such as odor, taste, and clogging of filters. Algal control methods are discussed for raw water supplies, recreational waters and fish ponds, treatment plants, and distribution systems. (Lynch-Wisconsin) W79-05322

#### ENVIRONMENTAL CHANGES FROM LONG-TERM LAND APPLICATION OF MUNICIPAL EFFLUENTS.

Environmental Protection Agency, Washington, DC. Office of Air and Water Programs.  
T. D. Hinesly, R. E. Thomas, and R. G. Stevens.  
Technical Report No. 430/9-78-003, June 1978. 32 p, 6 tab, 12 ref.

Descriptors: \*Municipal wastes, \*Sewage disposal, \*Land treatment, \*Land application, \*Bakersfield(CA), \*Lubbock(TX), \*Irrigation, \*Ultimate disposal, Groundwater, Chemical analysis, Environmental effects, Nitrogen, Phosphorus, Nutrients, Fertilization, California, Texas, Sewage treatment, Sludge treatment, Pastures, Surface irrigation, Sprinkler irrigation, Water pollution sources, Crop production, Beneficial use, Soils, Nitrates.

Soil and plant composition has not been noticeably affected by more than 35 years of waste effluent disposal on land around Bakersfield, California and Lubbock, Texas (except for soil phosphorus concentrations), but long-term sewage disposal on farm land seems to have caused unacceptable nitrate levels in groundwater. However, the groundwater contamination could be easily corrected at both sites by storing the effluent during the winter months and applying it so that nitrogen inputs are in balance with nitrogen uptake by crop plants. With such management soils at both sites potentially can remove contaminants from wastewaters for many more years. Chemical analyses were carried out March 1975 at Bakersfield and June 1976 at Lubbock. In both localities about 16 mg of effluent are applied throughout the year on row and forage croplands. In general, crop production has been increased by use of the sewage effluent for irrigation, compared with alternate water sources and commercial fertilizer used on neighboring farms. At Bakersfield sewage is aerated for six hours prior to solids removal in clarifiers, then surface irrigated. At Lubbock all land application is conducted by one local farmer, who recently installed center-pivot sprinklers. (Lynch-Wisconsin) W79-05323

#### PIGMENT COMPOSITION, PHOTOSYNTHESIS AND FINE STRUCTURE OF A NON-BLUE-GREEN PROKARYOTIC ALGAL SYMBIONT (PROCHLORON SP.) IN A DIDEMNID ASCIDIAN FROM HAWAIIAN WATERS.

Scripps Institution of Oceanography, La Jolla, CA. N. Withers, W. Vidaver, and R. A. Lewin.  
Phycologia, Vol 17, No 2, p 167-171, 1978. 2 fig, 1 tab, 13 ref.

Descriptors: \*Prochloron, \*Prochlorophyta, \*Endozoic organisms, \*Diplosoma virens, \*Pigments, \*Photosynthesis, \*Plant morphology, \*Marine algae, Algae, Prokaryotic algae, Ascidians, Hawaii, Coconut Island(Hawaii), Thylakoids, Cytological studies, Chlorophyll, Phycobillins, Carotenoids, Xanthophylls, Cyanophyta, Chlorophyta, Didemnids, Classification, Symbiosis, Benthic fauna.

A unicellular bright-green marine alga found growing endozoically in the didemnid ascidian (sea squirt) *Diplosoma virens* off Coconut Island, Oahu, Hawaii, is assigned to the new algal division, Prochlorophyta, and provisionally to the genus Prochloron. The alga is similar to cyanophytes in cell wall structure, in having prokaryotic cells, and in lacking organelles, but its photosynthetic lamellae (thylakoids) resembles that of eukaryotic chlorophyte chloroplasts more than that of a typical cyanophyte. Thylakoids tend to occur in pairs or stacks as in chlorophytes, and contain no detectable amounts of bilin pigments such as characterize blue-green algae, but have both chlorophyll-a and -b. Both isolated algal cells and those in the didemnid were capable of vigorous photosynthetic oxygen production in light. Maximum oxygen production was generally reached within one minute of illumination onset in isolated cells, and within two minutes with intact ascidian colonies. The cells were spherical, about 6-11 micrometers in diameter, and aqueous extracts was 6.5/1; a carotene fraction and several xanthophylls were also present. Betacarotene accounted for 71% of total carotenoids. Ultrastructural features of the alga are similar to those of the related epizoa alga *Prochloron didemni* from Mexican waters. (Lynch-Wisconsin) W79-05324

#### THE SHORT DAY RESPONSE IN ACROSMYPHYTON PURPURIFERUM (J. AG.) SJOST. (RHODOPHYCEAE, CRYPTONEMIALES).

Groningen Rijksuniversiteit (Netherlands). Dept. of Systemic Botany.  
A. M. Cortel-Breeman, and A. ten Hoopen.  
Phycologia, Vol 17, No 2, p 125-132, June 1978. 6 fig, 2 tab, 18 ref.

Descriptors: \*Photoperiodism, \*Acrosmyphton purpuriferum, \*Rhodophyta, \*Tetrasporangia, \*Life history studies, \*Light, Algae, Pigments, Light intensity, Cycles, Stolons, Sporulation, Growth stages, Plant growth, Seasonal, Spores, Thalli, Tetrasporophytes, Cryptonemiales, Critical day length, Short-day response.

Response of the red alga *Acrosmyphton purpuriferum* to short day length in terms of tetrasporangia formation in the tetrasporophyte differed from any known short-day response in algae or higher plants, and was mediated by a process other than the phytochrome mechanism. In *A. purpuriferum* the crustose tetrasporophyte produced tetrasporangia in short-day conditions (eight hrs light, 16 hrs dark) but not in long-day conditions (16 hrs light, eight hrs dark). At 12C with a short day length the first tetrasporangia were formed in eight days, and after 20 days all plants had formed tetrasporangia. A tetrasporangium sporulated 4-5 days after formation. As few as six short-day cycles were sufficient to induce a distinct response, and 15 cycles induced a response in all plants. Plants in which short-day cycles have induced a response continued to produce tetrasporangia in long-day conditions, but only in thallus parts which have been exposed to short-day conditions. The short-day response was unaffected by light breaks of white light or narrow-band colored light. The number of fertile plants decreased gradually with increasing day length over a broad range of light-dark re-

## Effects Of Pollution—Group 5C

gimes. Critical day length (at which 50% of the plants become fertile) was influenced by irradiance, with an increase in irradiance causing an increase in critical day length. (Lynch-Wisconsin) W79-05325

## STEADY-STATE ENERGETICS OF A PLANKTONIC HERBIVORE

Dunstaffnage Marine Research Lab., Oban (Scotland).

M. R. Droop, and J. M. Scott.

Journal of the Marine Biological Association of the United Kingdom, Vol. 58, No. 3, p 749-772, August 1978. 13 fig, 11 tab, 20 ref.

Descriptors: \*Brachionus plicatilis, \*Equilibrium, \*Energy transfer, \*Growth rates, \*Herbivores, \*Respiration, \*Zooplankton, \*Efficiencies, Algae, Tracers, Cobalt, Nutrients, Limiting factors, Vitamins, Vitamin B12, Nitrogen, Carbon, Rotifers, Assimilation, Food habits, Chemostats, Testing procedures, Transfer, Cultures, Excretion, Metabolism, Biomass, Input-output analysis, Fish food organisms, Food chains.

Growth rate and respiration were compared in a steady-state laboratory population of the small planktonic marine rotifer, *Brachionus plicatilis* (a fish food), with the alga *Brachiomonas submarina* as its food organism and cobalt-57-labelled vitamin B12 as the limiting nutrient. Ingestion and assimilation were high and not obviously dependent on growth rate, whereas growth efficiency correlated closely with growth rate; carbon and nitrogen excretion rates were finite at zero growth rate, increased rapidly with increasing growth rate, and tended toward infinity as maximum growth rate was approached. State variables were recorded at a number of steady states between zero dilution rate and washout, including: algal input biomass, algal (and fecal) output biomass, and rotifer (and gut) output biomass, in terms of carbon, nitrogen, and vitamin B12; and input and output of dissolved vitamin B12. From these were calculated input, ingestion, assimilation, excretion, and growth rates, and the associated transfer efficiencies. *B. plicatilis* was grown bacteria-free in a chemostat. Nitrogen and carbon excretion rates were correlated, and 'slow-adapted' and 'fast-adapted' modes of growth were distinguished, each having distinctive growth and energy parameters. (Lynch-Wisconsin) W79-05326

## PATTERNS OF PHOTOASSIMILATORY PRODUCTS IN PACIFIC RHODOPHYCEAE

Cologne Univ. (Germany, F.R.). Botanisches Inst. B. P. Kremer.

Canadian Journal of Botany, Vol. 56, No. 14, July 15, 1978, p 1655-1659. 1 fig, 2 tab, 21 ref.

Descriptors: \*Rhodophyta, \*Photoassimilation, \*Photosynthetic products, \*Floridosides, \*Digeneasides, \*Classification, Pacific Ocean, Oceans, Algae, Carbon radioisotopes, Heterosides, Carbohydrates, Ceramiales, Carbon, Assimilation, Photosynthesis, Floral lists, Tracers, Biochemistry.

Typical patterns of carbon-14-labelled photoassimilatory products were compared for 54 species of Pacific Rhodophyceae, representing 43 genera and six orders. The most strongly accumulated carbon-14-labelled carbohydrates of low molecular weight were the heterosides floridoside (2-O-D-glycerol-alpha-D-galactopyranoside) and digeneaside (2-D-glycerate-alpha-D-mannopyranoside). Carbon-14-labelled digeneaside is found only in Ceramiales and floridoside only in species of other orders. Accumulable soluble and insoluble end products of photosynthetic carbon reduction (particularly the diverse carbohydrates) have proved very useful for chemotaxonomic characterization of major taxa. Rhodophyceae differ from most other photoautotrophic plants by the occurrence of certain heterosides, such as the floridosides and a further glycoside, digeneaside. Occurrence and distribution of the soluble low-molecular-weight carbohydrates may reflect distinct relationships within the Rhodophyceae. As a percentage of total C-14-labelled assimilates, floridoside ranged from 27.8% in *Prionitis lanceolata* to 67.3% in *Scinaia john-*

stoniae, while digeneaside ranged from 7.4% in *Pterisiphonia dendroidea* to 32.3% in *Rhodomela laria*. (Lynch-Wisconsin) W79-05328

## COMPARISON OF ALGAE IN EUPLANKTON, TYCHOPLANKTON, AND PERIPHYTON OF A TUNDRA POND

Toronto Univ. (Ontario). Dept. of Botany.

R. G. Sheath, and J. A. Hellebust.

Canadian Journal of Botany, Vol. 56, No. 12, June 15, 1978, p 1472-1483. 7 fig, 1 tab, 42 ref.

Descriptors: \*Euplankton, \*Periphyton, \*Tycho-plankton, \*Algae, \*Tundra, \*Ponds, \*Species composition, \*Nora Pond (Northwest Territories, Canada), Plankton, Canada, Northwest Territories (Canada), Cold regions, Ice cover, Chlorophyta, Cyanophyta, Diatoms, Chrysophyta, Biomass, Primary productivity, Floral lists.

Species composition, biomass, and productivity were significantly different among three algal communities of Nora Pond, a tundra pond near Tuktoyaktuk, Northwest Territories, Canada, sampled during the ice-free period (June-September) of 1974. Euplankton (open water), tychoplankton (entangled among vegetation near shore), and periphyton (surface population of submerged objects or substrates) were sampled. Of 166 algal species identified, 125 were among the euplankton (36 unique to this group), 104 among tychoplankton (10 unique), and 109 in periphyton (15 unique). Chlorophyceae was represented by the greatest number of species, followed by Cyanophyceae, Bacillariophyceae, and Chrysophyceae. A large proportion of unique tychoplankton species were desmids (Chlorophyceae), whereas unique periphyton species were largely diatoms; species unique to the euplankton were fairly evenly distributed among the higher taxa. Each community exhibited two biomass increases, with slight timing differences. Major contributors to euplankton biomass were nannoplanktonic flagellates (Chrysophyceae), while periphyton was dominated by large, colonial, filamentous, or desmid Chlorophytes. Tychoplankton dominants were intermediate between those of the other two communities. During the July maximum euplankton primary productivity was slightly greater than that of tychoplankton, but in late August tychoplankton was five times more productive. (Lynch-Wisconsin) W79-05329

## THE CHEMICAL COMPOSITION OF AQUATIC MACROPHYTES. II. AMINO ACID COMPOSITION OF THE PROTEIN AND NON-PROTEIN IN FRACTIONS

Guelph Univ. (Ontario). Dept. of Nutrition.

A. J. Muztar, S. J. Slinger, and J. H. Burton.

Canadian Journal of Plant Science, Vol. 58, No. 3, July 1978, p 843-849. 3 tab, 14 ref.

Descriptors: \*Biochemistry, \*Macrophytes, \*Proteins, \*Amino acids, \*Nonprotein nitrogen, Nitrogen, Nutrients, Ontario (Canada), Canada, Lakes, Beneficial use, Cladophora glomerata, Chlora, Myriophyllum spicatum, Potamogeton, Vallisneria americana, Elodea canadensis, Lemna minor, Glutamic acid, Aspartic acid, Glycine, Leucine, Lysine, Arginine, Valine.

The amino acid profile, crude protein, and true protein (sum of all amino acids) levels of several species of aquatic macrophytes collected from lakes in Ontario, Canada 1974-75 were determined by acid hydrolysis followed by ion-exchange chromatography. Tryptophan was determined colorimetrically, and for some species total nitrogen was diffused to true protein nitrogen and nonprotein nitrogen using different solvents. Differences up to 6% were found between levels of crude protein and true protein. Major contributors to proteins were the nonessential amino acids glutamic acid, aspartic acid, and glycine, and the essential amino acids leucine, lysine, arginine, and valine. Levels of essential amino acids compared favorably with the FAO reference pattern and lead protein concentration. Determinations for nonprotein nitrogen (NPN) and free amino acids (FAA) remaining in

solution following precipitation of protein using 80% ethanol, 5% TCA, or 10% TCA were made for *Cladophora glomerata*, *Myriophyllum spicatum*, *Potamogeton* spp., and *Vallisneria americana*. Less total NPN remained in solution following ethanol extraction than either 5% or 10% TCA. In addition to amino acids normally occurring in protein, ornithine, citrulline, asparagine, glutamine, and gamma-amino butyric acid were also present in the NPN fraction. FAA content ranged about 6.6-16.8% total NPN, depending on species and extraction method. Analysis indicated this fraction could be nutritionally utilized by monogastric animals. (Lynch-Wisconsin) W79-05330

## THE UPTAKE, TRANSLOCATION AND METABOLISM OF DICHOLOBENIL IN SELECTED AQUATIC SPECIES

University of Strathclyde, Glasgow (Scotland). Dept. of Biology.

J. Mottley, and R. C. Kirkwood.

Weed Research, Vol. 18, No. 4, August 1978, p 187-198. 4 fig, 6 tab, 30 ref.

Descriptors: \*Dichlobenil, \*Translocation, \*Metabolism, \*Absorption, \*Rorippa nasturtium-aquaticum, \*Berula erecta, \*Phragmites communis, Herbicides, Watercress, Aquatic weed control, Path of pollutants, Tracers, Carbon radioisotopes, Evaporation, Leaves, Stems, Roots.

A study of the mode of action of the herbicide dichlobenil (2,6-dichlorobenzonitrile) using three species of aquatic weeds showed reedgrass (*Phragmites communis*) most susceptible, watercress (*Rorippa nasturtium-aquaticum*) moderately susceptible, and narrow-leaved water parsnip (*Berula erecta*) resistant. Susceptibility of *P. communis* coincided with relatively high accumulation of carbon-14-labelled dichlobenil or metabolites in the leaves, despite high loss of carbon-14 dichlobenil vapor. Resistance of *B. erecta* accompanied relatively low translocation of carbon-14 to the leaves and loss from the leaves, while moderate susceptibility of watercress was related to low accumulation in leaves and stems, reflecting very high rates of loss of carbon-14 dichlobenil vapor. The role of metabolism, if any, in selectivity of carbon-14 dichlobenil remains uncertain. Ten days after root treatment of the three species with five ppm C14-labelled dichlobenil in a vapor-trapping device, C14 absorbed and translocated by *P. communis* was 4-6 times greater than that for *B. erecta* and *R. nasturtium-aquaticum*, and 6-11 times more carbon-14 dichlobenil vapor was lost from the leaves of watercress than from the other two species. Distribution of radioactivity in roots, stems, and vapor of watercress was uniform, though movement of carbon-14 from the roots was restricted in *B. erecta*. In *P. communis* carbon-14 accumulated to the highest degree in stems (rhizomes) and leaves. (Lynch-Wisconsin) W79-05331

## CHARACTERIZATION OF THE NITRATE REDUCTASE ACTIVITY IN THE DIATOM SKELETONEMA COSTATUM

Bilbao Univ. (Spain). Dept. of Biochemistry.

J. L. Serra, M. J. Llana, and E. Cadenas.

Plant Science Letters, Vol. 13, No. 1, September 1978, p 41-48. 5 fig, 27 ref.

Descriptors: \*Diatoms, \*Skeletonema costatum, \*Nitrates, \*Reductase, \*Reduction (Chemical), \*Enzymes, \*Limiting factors, Nitrogen, Marine algae, Phytoplankton, Chrysophyta, Magnesium, Phosphates, Hydrogen ion concentration, Methodology, Testing procedures, Analytical techniques, Centric diatoms, Amino acids, Ammonium.

Nitrate reductase was easily extracted in cell-free extracts of the marine centric diatom *Skeletonema costatum* and showed magnesium and phosphate activation with an optimum pH of 7.9. The enzyme was easily extracted by rupturing the cells with a Teflon-pestle homogenizer, with 85% maximum extracted activity after homogenization for one min; glass fiber filters facilitated extraction. Nitrite formation was linear up to 60 min, and enzymatic



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

activity was proportional to protein concentration in crude extracts over at least a four-fold range.  $K_{sub m}$  was 0.24 mM for nitrate and 20  $\mu$ M for NADH. NADPH was substitutable for NADH as an obligatory electron donor, but with much less efficiency. Neither ammonium nor amino acids affected in-vitro activity, though ammonium exerted a rapid in-vivo inactivation of the NADH-nitrate reductase and associated activities. The enzyme is more ammonium-repressible than nitrate-inducible. Nitrate reductase activity has been described for a large number of higher plants, green algae, fungi, cyanophyceae, and bacteria, but little work has been done with marine phytoplankton. Present results for nitrate reductase from *S. costatum* do not differ significantly from other studies. Nitrate reduction is a particularly vital function of marine algae since nitrogen appears to be their rate-limiting nutrient and growth-controlling factor. (Lynch-Wisconsin)

W79-05332

#### INTRACELLULAR OXYGEN AND RADIOSENSITIZATION OF THE BLUE-GREEN ALGAE, *Akademija Nauk URSR*, Kiev, Plant Physiology Inst.

A. P. Dmitriev, N. I. Guchsa, and D. M. Grodzinsky. *Plant Science Letters*, Vol. 12, No. 3-4, August 1978, p 361-364. 2 fig, 12 ref.

Descriptors: \*Cyanophyta, \*Oxygen, \*Radiosensitivity, \*Photosynthesis, \*Anacystis nidulans, \*Carbon dioxide, \*Light, Chlorophyta, Chlorella pyrenoidosa, Algae, Nitrogen, Irradiation, Gamma rays, Anaerobic conditions, Chlorophyll.

Oxygen generated intracellularly in photosynthesis by the blue-green alga *Anacystis nidulans* radiosensitized the alga to almost the same extent as oxygen from extracellular sources. *A. nidulans* irradiated with gamma rays in the presence of carbon dioxide and light in anoxic conditions showed increased radiation sensitivity with an oxygen-enhancement ratio of 2.0, but neither light alone nor  $CO_2$  alone affected sensitization. The level of inactivation of oxygen-evolving photosynthesis was 30% nitrogen at a dose of 100 krad of gamma irradiation. The photoautotrophic prokaryotic cyanophytes (cyanobacteria) exhibit relatively low mutagenic efficiency of some physical and chemical factors as well as high resistance to gamma rays, indicating high genetic stability. There appear to be effective systems of recovery from lethal and pre-mutational lesions in DNA, and enzymatic photoreactivation and photorecovery after gamma irradiation that they possess a system analogous to the dark-repair type of bacteria. It is well-known that cell sensitivity to ionizing radiation is commonly increased two- to three-fold by oxygen presence. Irradiation effects on the chlorophyte *Chlorella pyrenoidosa* are also given. The photosynthetic system of *A. nidulans* was more sensitive than that of *Chlorella*, but the cyanophyte had a much higher survival rate than *Chlorella*, opposite to the radiation sensitivity of their photosynthetic systems. (Lynch-Wisconsin)

W79-05333

#### ON THE NUTRITION AND METABOLISM OF ZOOPLANKTON. XII. MEASUREMENTS BY RADIOIMMUNOASSAY OF THE LEVELS OF A STEROID IN CALANUS

Marine Biological Association of the United Kingdom, Plymouth (England). Plymouth Lab. S. C. M. O'Hara, E. D. S. Corner, and C. C. Kilvington.

*Journal of the Marine Biological Association of the United Kingdom*, Vol. 58, No. 3, p 597-605, August 1978. 18 fig, 3 tab, 23 ref.

Descriptors: \*Zooplankton, \*Steroids, \*Calanus helgolandicus, \*Analytical techniques, \*Radioimmunoassay, \*Estradiol-17 $\beta$ , \*Costs, Copepods, Cholesterol, Calanus finmarchicus, Norway, England, Metabolism, Nutrients, Methodology, Testing procedures, Measurements, Traces, Radioactivity techniques, Estrogens, Hormones, Bioassay, Lipids, Reproduction, Growth stages, Physiology.

Radioimmunoassay was used for the first time with zooplankton to detect and quantify the steroid sex hormone estradiol-17 $\beta$  (E2) in the copepods *Calanus helgolandicus* from Plymouth Sound, England, and *C. finmarchicus* from off the Norwegian Atlantic coast. E2 levels of 17.8-58.7 fg/animal were found in adult female *C. helgolandicus* collected in spring and summer, with maximum in early July. In adult males in spring and summer the level was 49.1 fg, and in stage V 43.8 fg. In females the steroid level was equivalent to .0000248% of cholesterol content and accounted for .00000141% of total lipid. In spring E2 concentration in stage V *C. finmarchicus* was .00000182-.00000203% of total lipid, and in stage V *C. helgolandicus* it was .0000006%. Cholesterol is known to have an important biological function in prawns and crabs, possibly as a precursor of such steroid hormones as the estrogen E2. Evidence of E2 in *Calanus* supports the view that these animals contain enzymes needed for synthesis of C18 steroids from cholesterol. A highly specific antibody, antiestradiol-6-carboxymethylloximine-BSA, was used in the tests. The radioimmunoassay technique consists of adding the antibody with a known quantity of isotope-labelled steroid to the sample, and estimating the quantity of labelled material bound by the antibody (which is inversely proportional to the unlabelled steroid) by radioactive counting. (Lynch-Wisconsin)

W79-05334

#### ALGAE OF SALTMARSHES ON THE SOUTH AND SOUTHWEST COASTS OF ENGLAND, Katholieke Univ., Nijmegen (Netherlands). Lab. voor Aquatische Oecologie.

P. J. G. Polderman. *British Phycological Journal*, Vol. 13, No. 3, p 235-240, September 1978. 16 ref.

Descriptors: \*Salt marshes, \*England, \*Algae, \*Estuaries, \*Bristol Channel(England), \*Coastal marshes, Species composition, Species richness, *Cladophora globulina*, *Vaucheria*, *Spartina*, *Bostrychia*, *scorpioides*, *Fucus*, *Wadden Sea(Netherlands)*, *Norfolk(England)*, *Flora lists*, *Cyanophyta*, *Chlorophyta*, *Porlock Weir(England)*, *Keyhaven(England)*, *Poole Harbor(England)*, *Sand Bay(England)*, *Berrow(England)*, Abundance, Dominant organisms, Netherlands, Islands.

Algal vegetation of three salt marshes along the Bristol Channel in southwestern England and two on the south coast of England was investigated 19-23 December 1975, and results were compared with data for Norfolk and the Wadden Sea area (Netherlands). Algal vegetation along the Bristol Channel was typically estuarine, as indicated by the abundance of *Vaucheria* compacts, and that of the south coast marshes was rich in species and communities. *Cladophora globulina* was newly reported for British marine flora (found in Poole Harbor marsh, Dorset). The other south coast marsh was Keyhaven (Hampshire), and the Bristol Channel marshes were Sand Bay (Avon), Berrow (Somerset), and Porlock Weir (Somerset). Twenty species of Cyanophyceae were identified, 14 Chlorophyceae, seven Zanthophyceae (*Vaucheria* spp.), six Phaeophyta, four Rhodophyta, one Haptophyceae, and one Chrysophyceae. The Porlock Weir salt marsh, with 21 species identified, was richer than the other two Bristol Channel marshes, but compared with salt marshes on the islands of the Dutch Wadden Sea which average 35 algal species, the Bristol Channel marshes are relatively poor in species. Allowing for the incompleteness of this study, the Bristol Channel marshes may average 25 species. Algal vegetation in the two southern marshes is very similar to that at Norfolk, and Poole Harbor with 36 species and Keyhaven with 38 compare favorably with the Wadden islands. (Lynch-Wisconsin)

W79-05335

#### THE PHYTOPLANKTON CHARACTERISTICS OF THE BARRIER ISLAND LAGOONS OF THE GULF OF CALIFORNIA

Maine Univ. at Orono. Center for Marine Studies. M. Gilmartin, and N. Revelante.

*Estuarine and Coastal Marine Science*, Vol. 7, No. 1, p 29-47, July 1978. 5 fig, 7 tab, 34 ref. NSF GA3127-IX and GF 31947X.

Descriptors: \*Gulf of California(Mexico), \*Phytoplankton, \*Lagoons, \*Eutrophication, \*Baja California(Mexico), \*Primary productivity, Gulfs, Seas, Pacific Ocean, Oceans, Mexico, Algae, Barrier islands, Tidal effects, Chlorophyll, Salinity, Flushing rate, Species composition, Upwelling, Species diversity, Floral lists, Nutrients, Standing crops, *Thalassionema nitzschoides*, *Skeletonema costatum*, Assimilation number, Water temperature, Nearshore zone, Coasts, Sampling.

Comparative study of 15 lagoons on the Gulf of California and of the open gulf conducted July-August 1972 (during lowest upwelling and before the rainy season) showed that the lagoons markedly influence phytoplankton productivity in eastern inshore waters of the central gulf. A dramatic inshore increase was found in cell densities, chlorophyll-a standing crop, and primary production rate. Increased phytoplankton activity in the gulf has usually been attributed to nutrient input from upwelling, and to a lesser degree to tidal mixing in island channels. Positive correlation was established among lagoon flushing rates, nutrients, chlorophyll-a biomass (to over 19.5 mg/cu m), and primary production (to over 185 mg C/cu m/hr), apparently related to lagoon trapping of nutrients and/or eutrophication. Positive correlation was also found between lagoon assimilation number (to over 12.5) and temperature (to over 31C). Particularly noteworthy were the high assimilation values in inshore waters—well in excess of five, and indicative of eutrophic conditions. Such values, correlated with tidal flushing indices and the characteristics of the lagoon waters clearly indicate the positive influence of the lagoons on primary production of the eastern gulf. *Thalassionema nitzschoides* and *Skeletonema costatum* were the most important species in the eastern lagoons. Sixty-one stations were sampled between Bahía de los Angeles and Estero de Urias. (Lynch-Wisconsin)

W79-05337

#### NITROGEN FIXATION (ACETYLENE REDUCTION) BY EPIPHYTES OF FRESHWATER MACROPHYTES

Cornell Univ. Medical Coll., New York. Dept. of Microbiology. L. R. Finke, and H. W. Seeley, Jr. *Applied and Environmental Microbiology*, Vol. 36, No. 1, p 129-138, July 1978. 6 fig, 2 tab, 44 ref.

Descriptors: \*Nitrogen fixation, \*Epiphytes, \*Acetylene reduction, \*Myriophyllum spicatum, \*Nitrogen fixing bacteria, \*Cyanophyta, \*Eutrophication, \*Photosynthesis, Macrophytes, Biorhythms, Ethylene, Seasonal, Microorganisms, Bacteria, Cyanobacteria, Gloeotrichia, *Rhodospseudomonas*, *Dryden Lake(NY)*, *Cayuta Lake(NY)*, New York, Nitrogen, Algae, Lakes, Ponds, Bioassay, Eurasian water milfoil.

In eutrophic water with extensive macrophyte growth, epiphytic blue-green algae and photosynthetic bacteria may contribute significantly to nitrogen fixation, based on a 1973 survey of epiphytes in lakes and ponds near Ithaca, New York and on a detailed study 1974-75 in one experimental pond. Acetylene reduction was used to estimate nitrogen fixation by epiphytes in *Dryden* and *Cayuta* Lakes and in several experimental ponds, and to follow diel and seasonal cycles of nitrogen fixation by epiphytes of *Myriophyllum spicatum* (Eurasian water milfoil) at the experimental site during the longer study. All plant samples collected during the survey showed some acetylene reduction. Experiments showed heterocystous blue-green algae (cyanobacteria), especially *Gloeotrichia*, to be primarily responsible for nitrogen fixation, but photosynthetic bacteria of the genus *Rhodospseudomonas* isolated from *M. spicatum* also showed high rates of acetylene reduction. Acetylene reducing activity was highest noon-6 pm, but also continued through the night. Activity began in May, abruptly increasing to 0.45-0.95 nmols ethylene/mg plant dry wt/hr. During summer mean rates remained between 0.15-0.60



## Effects Of Pollution—Group 5C

Abundance, Water temperature, Predation, Fish, Jakle's Lagoon(WA), Saline water, Tidal effects, Life history studies, Growth stages, *Gasterosteus aculeatus*, Fish food organisms.

Seasonal abundance of the planktonic marine copepod *Acartia clausii* in small, temperate Jakle's Lagoon on the southern end of San Juan Island, Washington is controlled by an annually consistent pattern of copepod and adult mortality believed due to predation by the lagoon's dominant fish, the three-spined stickleback (*Gasterosteus aculeatus*). Population abundance is further regulated by cannibalism and periodic tidal stimulation of egg hatching accumulated in the sediment. Population size increases rapidly in March and April, rises to a maximum in late June (about three million/sq m), and declines through July and August. Production of the lagoon population was 229 kg C over a two-year study period (1973-74), with 84-88% occurring April-July. Below a depth of three meters mean daily production during peak months was 70 mg C/sq m in 1973 and 55 mg in 1974. Seasonal changes were analyzed through integrated laboratory and in-situ experiments with time-series sampling of the field population; development, growth, fecundity, and mortality were investigated. Cycles of abundance, similar in the two study years, were not affected by differences in cycles of tidal inflow, temperature, or food availability; but the latter two appreciably affected rates of growth, development, and fecundity. The lagoon is separated from Grifin Bay by a bar of gravel and driftwood and is bounded on three sides by forest. Runoff is the only source of freshwater inflow. (Lynch-Wisconsin)

W79-05346

## PRODUCTIVITY STUDIES ON BALTIC MACROALGAE,

Stockholm Univ. (Sweden). Inst. of Botany.

I. Wallentinus.

Botanica Marina, Vol. 21, No. 6, p 365-380, August 1978. 8 fig, 3 tab, 26 ref.

Descriptors: \*Baltic Sea, \*Primary productivity, \*Algae, \*Chlorophyta, \*Phaeophyta, \*Rhodophyta, Seas, Carbon radioisotopes, Seasonal, Macrophytes, Sweden, Archipelagos, Chorophyll, Photosynthesis, Photosynthetic index, Monostroma grevillei, Acrosiphonia centralis, Cladophora glomerata, Pilayella littoralis, Scytosiphon lomentaria, Dictyosiphon lomentaria, Dictyosiphon foeniculaceus, Furcellaria fastigiata, Phyllophora t. ncata, Ceramium tenuicorne, Rhodomela confervoides.

Intraspecific primary productivity varied as much as tenfold for the macroalgae *Cladophora glomerata* (1.5-11.4 mg C/g dry wt/hr), *Ceramium tenuicorne* (0.8-8.5 mg C), and *Pilayella littoralis* (0.6-6.1 mg C) in studies performed in-situ in the northern Baltic Sea and in a laboratory incubator using the carbon-14 method. Results suggest that productivity values should be given together with such physiological characteristics as chlorophyll or nitrogen content, to facilitate evaluation of the influence of environmental variables. Intraspecific variation can greatly exceed interspecific variation for different species grown under similar conditions. Expressing results as mg C assimilated per mg chlorophyll-a (photosynthetic index) often reduces differences considerably, both within and among species. The 10 algal species investigated were studied seasonally in the Baltic Sea archipelago south of Stockholm, Sweden. Species were the chlorophytes *Monostroma grevillei*, *Acrosiphonia centralis*, and *Cladophora glomerata*; the phaeophytes *Pilayella littoralis*, *Scytosiphon lomentaria*, and *Dictyosiphon foeniculaceus*; and the rhodophytes *Furcellaria fastigiata*, *Phyllophora truncata*, *Ceramium tenuicorne*, and *Rhodomela confervoides*. Influence of sample size and length is discussed. Twenty-four-hour experiments were used to calculate turnover times for four species. (Lynch-Wisconsin)

W79-05347

nmol, gradually declined in fall, and ceased in January and February. Epiphytes added 7.5-12.5 micrograms N/mg plant/yr to the pond, a significant amount relative to the total amount of nitrogen incorporated into *M. spicatum*. (Lynch-Wisconsin)

W79-05338

## PHYSICAL QUALITY AND SEDIMENT TRANSPORT IN DRAINAGE WATER FROM A MANURED AND FERTILIZED CROPPING OPERATION,

Department of Agriculture, Ottawa (Ontario). Animal Research Inst.

For primary bibliographic entry see Field 5G. W79-05339

## MERCURY IN SEDIMENTS OF LAKE PAIJANNE, FINLAND,

Jyväskylä Univ. (Finland). Dept. of Biology.

J. Sarkka, M. L. Hattula, J. Janatuinen, and J. Paasivirta.

Bulletin of Environmental Contamination and Toxicology, Vol. 20, No. 3, September 1978, p 332-339. 2 fig, 2 tab, 23 ref.

Descriptors: \*Mercury, \*Sediments, \*Water pollution effects, \*Lake Paijanne(Finland), \*Bioaccumulation, \*Path of pollutants, \*Pulp and paper industry, Finland, Lakes, Food webs, Pollutants, Industrial wastes, Food chains, Slimicides, Caustic soda, Heavy metals, Sedimentation.

Of an estimated 82 kg mercury discharged per year during 1953-66 into Lake Paijanne, Finland from pulp and paper wastes, a great part did not settle into sediments, but instead found its way into various levels of the food chain. Fairly high mercury content was found in plankton, zoobenthos, aquatic plants, fish, and birds during sampling in the summers of 1972-74. Total mercury discharged averaged 750 micrograms Hg/sq m/yr over the lake's 1090 sq km. Average sedimentation of about 0.6 mm/yr, or 600 g/sq m/yr as wet wt (about 192 g/sq m/yr dry wt) would mean sediment layer content of about 3900 micrograms Hg/kg, but the mean for all samples was only 360 micrograms Hg/kg. For the upper layer in profundal depths the mean was 340 micrograms/kg, and for the lower layer it was 610 micrograms/kg. Although the highest mercury levels were found in lower layers at stations 1 and 2 where most of the mercury was discharged, the maximum level was only 1090 micrograms/kg. However, high levels relative to probable natural levels found in profundal depths of stations 3 and 4 show that the mercury was transported into sediments located relatively distant from the pollutant's origin. Mercury was used as a slimicide by the pulp and paper industry until 1968, and also appeared as an impurity in caustic soda. About 20% of the total 4.1 tons/yr discharged into Finnish waters 1953-66 went into Lake Paijanne. (Lynch-Wisconsin)

W79-05340

## EFFECT OF ALGAL DIET AND TEMPERATURE ON THE BIOCHEMICAL COMPOSITION OF THE ROTIFER, BRACHIONUS Plicatilis,

Ministry of Agriculture, Fisheries and Food, Lowestoft (England).

A. P. Scott, and S. M. Baynes.

Aquaculture, Vol. 14, No. 3, July 1978, p 247-260. 2 fig, 6 tab, 17 ref.

Descriptors: \*Brachionus plicatilis, \*Rotifers, \*Water temperature, \*Biochemistry, \*Fish food organisms, \*Food habits, \*Limiting factors, \*Fish farming, \*Aquaculture, Algae, Growth rates, Weight, Carbohydrates, Proteins, Data collections, *Dunaliella tertiolecta*, *Pavlova lutheri*, *Phaeodactylum tricornutum*, *Isochrysis galbana*, *Turbid*, *Scopthalmus maximus*, *Anchovy*, *Engraulis mordax*, *Siganus lineatus*, Larvae.

Type of alga used as food for the rotifer *Brachionus plicatilis* had little effect on growth rate, weight, or level of total protein, carbohydrate, or lipid; however, weight and biochemical composition

were strongly affected by differences in water temperature and amount of food available. These rotifers are used extensively as live food for rearing small larval fishes such as turbot (*Scopthalmus maximus*), anchovy (*Engraulis mordax*), and *Siganus lineatus*. In tests they were fed four unicellular algal species, *Dunaliella tertiolecta*, *Pavlova lutheri*, *Phaeodactylum tricornutum*, and *Isochrysis galbana*. In contrast with *Artemia salina*, whose growth rate was greatly affected by type of algae used as food, the only significant effect of algal species was that rotifers fed on *D. tertiolecta* were consistently richer in carbohydrate. On the other hand, at low temperatures (18°C) rotifers consumed their food fairly slowly and maintained relatively high lipids and carbohydrates for a long period, while at high temperatures (28°C) food was consumed quickly and composition of the rotifers declined rapidly when food was gone. The significant fall in weight and biochemical composition (though not in size) with starvation indicates the importance of keeping the rotifers well-fed in larval fish rearing tanks. (Lynch-Wisconsin)

W79-05341

## SUBSTRATE SELECTION BY LARVAE OF THE SESSILE ROTIFER PTYGURA BEAUCHAMPI,

Dartmouth Coll., Hanover, NH. Dept. of Biological Sciences.

R. L. Wallace.

Ecology, Vol. 59, No. 2 1978, p 221-227, 3 fig, 3 tab, 27 ref. NSF BMS 75-03107, DEB 75-03175.

Descriptors: \*Larvae, \*Symbiosis, \*Ptygura beauchampi, \*Utricularia vulgaris, \*Rotifers, \*Carnivorous plants, \*Epiphytes, \*Predation, Sessile organisms, Utricularia, Habitats, Substrates, Kairomones, Trichomes, Allomones, Commensal, Invertebrates, Benthic fauna, Benthic flora.

Larvae of the sessile rotifer *Ptygura beauchampi* begin substrate selection activities (presettling movement, attachment, and metamorphosis) upon chemotactile sensing of a stimulus released by the terminal heads of glandular trichomes covering *Utricularia vulgaris*, a carnivorous plant which is the preferred substrate of the rotifer. *P. beauchampi* attaches itself to the trapdoor region of the large prey-capturing Organism of *U. vulgaris*. The stimulus, a stable, chemical substance, arises from the head cell of trichomes when they reach a certain developmental stage, characterized by splitting and dislodgment of the cuticular sheath and subsequent formation of bacterial-mucilage complex (which is not the source of the stimulus). The chemical substance, an allelochemical agent which is probably present inside young trichomes but not released, may be the utricularian prey-lure proposed by Cohn in 1875. Four other co-occurring, congeneric species (*U. gibba*, *U. inflata* minor, *U. intermedia*, and *U. purpurea*) and two smaller and morphologically distinct trap types of *U. vulgaris* were not colonized. All of the *Utricularia* traps except *U. purpurea* have glandular trichomes which are nearly identical. The symbiotic relationship is commensal because rotifers colonize but do not feed on the plant or its prey (deriving mainly a refuge from predation), and because the plant is unaffected by the colonization. (Lynch-Wisconsin)

W79-05345

## POPULATION DYNAMICS AND PRODUCTION OF A PLANKTONIC MARINE COPEPOD, ACARTIA CLAUSII, IN A SMALL TEMPERATE LAGOON ON SAN JUAN ISLAND, WASHINGTON,

California Univ., San Diego, La Jolla. Inst. of Marine Resources.

M. R. Landry.

Internationale Revue der Gesamten Hydrobiologie, Vol. 63, No. 1, p 77-119, 1978. 28 fig, 47 ref. NSF DES 74-22640.

Descriptors: \*Acartia clausii, \*Copepods, \*Zooplankton, \*Lagoons, \*Population dynamics, \*Productivity, Washington, San Juan Island(WA), Islands, On-site tests, Laboratory tests, Time series analysis, Seasonal, Mortality, Fecundity, Cycles,

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

**REGENERATION OF THALLUS FRAGMENTS OF RHODOCHORTON PURPUREUM (RHODOPHYCEAE, NEMALIONALES),** Purdue Univ., Lafayette, IN. Dept. of Botany and Plant Pathology.  
N. L. Pearlmuter, and R. L. Vadas.  
Phycologia, Vol. 17, No. 2, p 186-190, June 1978. 12 fig, 17 ref.

**Descriptors:** \*Rhodochorton purpureum, \*Thalli, \*Reproduction, \*Regeneration, \*Fragmentation, \*Plant growth, \*Vegetative reproduction, Algae, Rhodophyta, Nemalionales, Cultures, Rhizoids, Apical cells, Filamentous algae, Salinity, Growth stages, Maine, Intertidal areas, Spores, Habitats, Asexual reproduction.

Cut filament fragments of the rhodophyte alga *Rhodochorton purpureum* regenerated readily in laboratory culture, suggesting that dispersion of this species in intertidal habitats may result from thallus fragmentation caused by wave action. Fragmentation, or vegetative propagation, may thus explain the presence of algae in environments where such factors as temperature or light are unfavorable for reproduction by spore germination. *R. purpureum* was collected from beneath *Ascophyllum nodosum* at Thunder Hole on Mt. Desert Island, Maine, in November 1972, cut with a razor blade, and grown in Provasoli medium of varying salinity. Most fragments produced an adhesive rhizoid from one cut end of the filament before a shoot or another rhizoid developed from the opposite cut end. Patterns of regeneration by unbranched fragments 1-10 cells long without apical cells of 7%, 17%, and 31% salinity were similar, but filaments grew most rapidly in 17%. Regeneration was detectable 24-48 hrs after thalli were fragmented and placed in fresh medium. Within 20 days 89% of the fragments had regenerated new cells from one or both cut ends. Apical fragments were studied in medium of 17% salinity, and intact apical cells on fragments did not appear to inhibit regeneration or branch initiation. Any cell of *R. purpureum* can potentially regenerate a new thallus, an event apparently triggered by removal of an abutting cell. (Lynch-Wisconsin)  
W79-05349

**PHYTOPLANKTON PRODUCTION AT TWO STATINS IN LINDA-SPOLLENE, A NORWEGIAN LAND-LOCKED FJORD, AND LIMITING NUTRIENTS STUDIED BY TWO KINDS OF BIO-ASSAYS,** Bergen Univ. (Norway). Inst. of Marine Biology. C. Lannergren.  
Internationale Revue der Gesamten Hydrobiologie, Vol. 63, No. 1, p 57-76, 1978. 11 fig, 43 ref.

**Descriptors:** \*Analytical techniques, \*Bioassay, \*Phytoplankton, \*Primary productivity, \*Lindaspollene (Norway), \*Limiting factors, \*Fjords, \*Testing procedures, Methodology, On-site tests, Norway, Chlorophyll, Species composition, Phosphates, Nitrates, Silicates, Salinity, Algae, Nutrients, Sewage disposal, Water pollution effects, Carbon, Nitrogen, Nanoplankton, Laboratory tests.

Field and laboratory bioassays were made of primary productivity, chlorophyll-a concentrations, and quantity and composition of phytoplankton at two stations in Lindaspollene, a Norwegian land-locked fjord. Station 1 in Spjeldnesen was more influenced by freshwater runoff than station 2 in Straumsosen, and in 1972 sewage discharge to Spjeldnesen was about doubled by addition of a new outfall. Station 1 was characterized by frequent low salinities and high nutrient content, and station 2 by higher and more stable salinities and somewhat lower nutrient levels. In the field bioassay combinations of phosphate, nitrate, and silicate were added to natural water in-situ, and in the laboratory bioassay natural water was incubated. Although the bioassays showed nitrogen to be the main limiting nutrient, the biological parameters showed no consistent differences between the two stations, tentatively explained by the growth of nanoplankton which depended on nutrients other than those analyzed. There was no correlation between nitrate content and in-situ carbon assimila-

tion rates in the field bioassay, and there was no significant difference in phytoplankton biomass or production rates between the two stations, despite the fact that average nitrate content was higher at station 1 and higher yields were obtained with water from station 1 in the laboratory bioassay. (Lynch-Wisconsin)  
W79-05350

**PHYTOPLANKTON PRIMARY PRODUCTIVITY AND POPULATION EFFICIENCY STUDIES IN A PRAIRIE-PARKLAND LAKE NEAR EDMONTON, ALBERTA, CANADA,** Alberta Univ., Edmonton. Dept. of Botany. M. Hickman, and C. G. Jenkinson.  
Internationale Revue der Gesamten Hydrobiologie, Vol. 63, No. 1, p 1-24, 1978. 14 fig, 65 ref.

**Descriptors:** \*Phytoplankton, \*Primary productivity, \*Standing crops, \*Hastings Lake (Alberta, Canada), \*Light intensity, \*Eutrophication, \*Photosynthesis, Canada, Alberta (Canada), Lakes, Chlorophyll, Carbon, Efficiencies, Depth, Stratification, Algae, Microcystis aeruginosa, Gomphonema lacustris, Cyanophyta, Chlorophyta, Flagellates, Chlamydomonas globosa, Cryptomonas ovata, Rhodomonas minuta.

Phytoplankton standing crop and primary productivity were both high in Hastings Lake, a relatively small, edaphically eutrophic, prairie-parkland lake east of Edmonton, Alberta, Canada, and productivity declined with light intensity at lower depth. Mean standing crop was 29.24 mg chlorophyll-a/cu m, or 73.09 mg/sq m, and mean primary productivity was 78.71 mg C/hr/cu m, or 196.77/sq m. From summer to early winter phytoplankton was dominated by cyanophytes, *Microcystis aeruginosa* in particular, and also *Gomphonema lacustris*, *Anabaena circinalis*, and *Oscillatoria* sp. Under the winter ice cover phytoplankton was dominated by the flagellated algae *Chlamydomonas globosa*, *Cryptomonas ovata*, *Rhodomonas minuta*, and to a lesser extent *Gonium sociale*. There was a winter minimum, and spring and late summer maxima. Primary productivity was low during winter and undetectable below three meters. The relationships between primary productivity and incident solar radiation and between maximum productivity and water temperature were significant, but that between productivity and standing crop was not. Determination of primary productivity efficiency provided a negative regression with light intensity; a logarithmic curve fit the data best. Seasonal changes in photosynthetic indices were closely related to incident solar radiation. (Lynch-Wisconsin)  
W79-05351

**EFFECT OF SULFUR DIOXIDE ON ALGAE,** Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy. R. S. Wodzinski, and M. Alexander.  
Journal of Environmental Quality, Vol. 7, No. 3, p 358-360, 1978. 2 tab, 10 ref. U.S. EPA R-803691.

**Descriptors:** \*Anabaena flos-aquae, \*Chlamydomonas reinhardtii, \*Sulfur dioxide, \*Toxicity, \*Photosynthesis, \*Air pollution effects, \*Water pollution effects, Soil types, Lima loam soil, Algae, Sulfur, Bisulfite, Poisons, Pollutants, Chlorophyta, Cyanophyta, Acidity, Hydrogen ion concentration, Soil contamination, Buffers, Phosphates, Soils.

Laboratory tests showed that photosynthesis of both the blue-green alga *Anabaena flos-aquae* and the green alga *Chlamydomonas reinhardtii* are almost totally inhibited by 1.0 ppm airborne sulfur dioxide (SO<sub>2</sub>) in 24 hrs. Previous work showed that blue-green algae were 10 times more sensitive to bisulfite than green algae, suggesting that if true also for sulfur dioxide significant inhibition of cyanophytes may occur at SO<sub>2</sub> concentrations much lower than 1.0 ppm. Sulfur dioxide toxicity increases with decreasing pH, indicating that SO<sub>2</sub>-polluted air may be particularly harmful in ecosystems with low pH or those in which pH is lowered by acid precipitation from SO<sub>2</sub> or other air pollutants. In these tests, *A. flos-aquae* and *C. reinhardtii*

photosynthesis was almost completely inhibited in a thin layer of Bristol's medium at an initial pH of 6.0 exposed to air with 1.0 ppm SO<sub>2</sub>. The pH of the medium decreased to 5.2 or below during the test, but addition of soil or phosphate buffer to prevent the decrease in pH resulted in no inhibition of photosynthesis. Addition of acidic soil to a medium of pH 4.9 offered no protection from adverse SO<sub>2</sub> effects. Photosynthetic inhibition may not be caused solely by increased hydrogen ion concentration, since control samples at pH below 5.0 continued to demonstrate photosynthetic activity. In Lima loam soil of pH 7.1 photosynthesis was unaffected by exposure to 0.5 ppm SO<sub>2</sub> in air. (Lynch-Wisconsin)  
W79-05352

**SOME ASPECTS OF SEDIMENT DISTRIBUTION AND MACROPHYTE CYCLING OF HEAVY METALS,** Purdue Univ., Lafayette, IN. Dept. of Bionucleonics. A. W. McIntosh, B. K. Shephard, R. A. Mayes, G. J. Atchinson, and D. W. Nelson.  
Journal of Environmental Quality, Vol. 7, No. 3, p 301-305, July-September 1978. 4 fig, 45 tab, 15 ref. NSF-RANN G135106.

**Descriptors:** \*Sediments, \*Heavy metals, \*Macrophytes, \*Path of pollutants, \*Cadmium, \*Zinc, \*Palestine Lake (IN), \*Aquatic weed control, Indiana, Distribution, Lakes, Eutrophication, Herbicides, Chemcontrol, Water pollution effects, Aerial photography, Potamogeton crispus, Industrial wastes, Electroplating, Poisons, Pollutants, Shallow water, Effluents.

Cadmium and zinc distribution in sediments of shallow, eutrophic, 93-ha Palestine Lake (Kosciusko County, Indiana) contaminated by wastes from an electroplating company, was investigated 1975-76, as was potential release of accumulated cadmium from a massive infestation of the macrophyte *Potamogeton crispus* subsequently treated with herbicides in May 1976. Cadmium levels in the upper five cm of sediments ranged from 2.54 ppm in the unpolluted northeastern basin to 805 ppm near the entrance of waste effluent-bearing Williamson Ditch to the lake's western basin. Corresponding zinc levels were 115 ppm in unpolluted sediments and 6120 ppm near the ditch entrance. In polluted areas metal contamination reached to a depth of 30 cm. Contamination levels in the west basin were much higher than those reported for most other systems, including Lake Erie. Dominant forms were the carbonate for cadmium, and carbonate and organic for zinc. Analysis of *P. crispus* indicated cadmium levels as high as 89.6 ppm, with a maximum burden of 1.5 kg Cd in the entire population. Release of the total amount could raise water pollution concentrations by a maximum of 1 microgram/liter. Standing crop of the dense populations of *P. crispus*, which completely filled much of the lake by mid April 1976, was estimated by low-level oblique color infrared aerial photographs. Alkalinity in lake water ranged 84-318 ppm in the form of CaCO<sub>3</sub>, and hardness was 190-360 ppm as CaCO<sub>3</sub>. (Lynch-Wisconsin)  
W79-05353

**COMMUNITY PRODUCTION AND RESPIRATION BY CILIATED PROTOZOA IN THE BENTHOS OF A SMALL EUTROPHIC LOCH,** Stirling Univ. (Scotland). Dept. of Biology. B. J. Finlay.  
Freshwater Biology, Vol. 8, No. 4, p 327-341, 1978. 11 fig, 5 tab, 47 ref.

**Descriptors:** \*Biological communities, \*Airthrey Loch (Scotland), \*Eutrophication, \*Protozoa, \*Productivity, \*Respiration, \*Benthic fauna, Lochs, Lakes, Ciliated protozoa, Depth, Biomass, Typha latifolia, Loxocephalus plagiatus, Scotland, Energy.

Annual production of benthic ciliate protozoa in 1975-76 at three sites in 10-ha, shallow, highly eutrophic Airthrey Loch, Scotland decreased with increasing depth. Production was estimated at 345 J/sq cm/yr at site A in shallow water at the edge



## Effects Of Pollution—Group 5C

of the small loch, 149 J at site B (0.8-1.8 m depth) in the *Typha latifolia* beds of the main loch. Annual respiratory energy losses also decreased with depth—16, 11, and 4 J/sq cm/yr at the three sites. Corresponding annual net production efficiencies for each period between sampling dates as 100 (daily production/daily assimilation) gave a range of 63-98. There are few published estimates of protozoan production, and no detailed studies of total ciliate faunal production, but it appears that figures for ciliates given here are at the upper end of the range for zoobenthic production. The high ciliate production values are especially notable in light of the very low respiratory energy losses. Summer biomass peaks were due to: (1) higher populations, and (2) increased proportion of ciliates in the larger size class. Much of the variation at sites A and B was caused by the sudden appearance of large numbers of *Loxoccephalus plagiatus*. (Lynch-Wisconsin)  
W79-05354

#### STABILITY AND COMPOSITION OF TERRESTRIALLY DERIVED DISSOLVED ORGANIC NITROGEN IN CONTINENTAL SHELF SURFACE WATERS.

Skidaway Inst. of Oceanography, Savannah, GA. W. S. Gardner, and J. A. Stephens. Marine Chemistry, Vol. 6, No. 4, p. 335-342, 1978. 2 fig. 2 tab. 21 ref. NSF OCE72-06423.

Descriptors: \*Continental shelf, \*Dissolved organic nitrogen, \*Dissolved organic carbon, \*Nutrients, \*Atlantic Ocean, \*Stability, \*Sea water, Georgia, Wassaw Sound(GA), South Atlantic Bight, Oceans, Carbon, Nitrogen, Coasts, Rivers, Salinity, Amino acids.

A linear decrease in dissolved organic carbon (DOC) and nitrogen (DON) with increasing salinity in surface water samples collected April 1977 on a transect 0-100 km off the Georgia Coast from Wassaw Sound suggests that organic nitrogen compounds contributed to coastal waters by rivers are stable during the 2-3 month period of their transfer over the continental shelf. While the carbon-nitrogen ratio decreased with distance from shore, total DON, total amino nitrogen, and primary amino nitrogen showed similar relative decreases, suggesting that nitrogen is associated with refractory organic compounds. Measured amino nitrogen accounted for about 20% of total DON, leaving about 80% of the organic nitrogen undefined. Substantial quantities of organic nitrogen compounds are added to coastal waters by rivers; about 5% of shelf water volume in the South Atlantic Bight is contributed annually by rivers. Salinities of the 20 samples collected from the transect ranged from 25‰ near shore to 35‰ 100 km offshore. The largest gradient occurred in the first 30 km. Linear correlation of DOC with salinity was highly significant ( $r=0.98$ ,  $p < 0.001$ ), and was also significant for DON ( $r=0.89$ ,  $p < 0.001$ ), though the relative seaward decrease was less for DON than for DOC. The C/N ratio was 15 at the nearshore end, compared with 11 for the seaward portion. The data suggest that most biological and chemical changes affecting river-derived DOC and DON have occurred by the time river water reaches the shore line. (Lynch-Wisconsin)  
W79-05355

#### SOME ECOLOGICAL OBSERVATIONS ON A PERMANENT POND IN SOUTHERN ENGLAND: PRIMARY PRODUCTION AND PLANKTONIC SEASONAL SUCCESSION.

Oxford Univ. (England). Dept. of Zoology; and Oxford Univ. (England). Animal Ecology Research Group. A. R. Russeo.

Hydrobiologia, Vol. 60, No. 1, p. 33-48, 1978. 21 fig. 42 ref.

Descriptors: \*Succession, \*Ecology, \*Ponds, \*Primary productivity, \*Phytoplankton, \*Zooplankton, \*Radley Pond(United Kingdom), \*Seasonal, Alkalinity, United Kingdom, Permanent ponds, Cryptomonas, Diatoms, Chrysophyta, Algae, Macrophytes, Ceratophyllum demersum, Biomass, Volvox ureus, Copepods, Cladocera.

A study of Radley Pond, a 0.9-ha natural, permanent, alkaline pond near Oxford in Southern England September 1976-August 1977 showed that phytoplankton productivity was highest during spring and fall, and gross primary productivity was normal for shallow lakes and artificial ponds. Hourly rates of phytoplankton photosynthesis ranged from almost zero in winter to 475 mg C/cu m/hr in fall. Daily gross primary productivity per unit area varied 0.1-2.5 g C/sq m/day, and annual gross primary productivity of phytoplankton was estimated at .157 kg C/sq m/yr. Net primary productivity of open-water phytoplankton was about half that of pond macrophytes, dominated by *Ceratophyllum demersum*, which densely covered over 55% of the pond in summer. Peak biomass was 235 g (ash free)/sq m in July, and net annual primary productivity was 2.89 metric tons (ash free)/ha/yr. Net phytoplankton energy production was 3.29 million J/sq m/yr, compared with 6.25 million for macrophytes. Net production efficiencies ranged from .11% for phytoplankton to .21% for macrophytes. In fall during abnormally heavy rains, phytoplankton growth was intense, especially for the colonial alga *Volvox aureus*. Diatoms were abundant most of the year, with peaks during the fall and spring blooms. Zooplankton consisted of single-species associations with cladocerans and copepods dominant throughout the year; distinct general seasonal successions were observed. (Lynch-Wisconsin)  
W79-05356

#### DISSOLVED GLUCOSE IN A BAYOU ESTUARY, POSSIBLE SOURCES AND UTILIZATION BY BACTERIA.

University of West Florida, Pensacola. Faculty of Biology. G. A. Moshiri, W. G. Crumpton, and N. G. Aumen.

Hydrobiologia, Vol. 62, No. 1, p. 71-74, 1979. 3 fig. 11 ref. OWRT B-024-FLA(7), 14-31-0001-5065.

Descriptors: \*Glucose, \*Estuaries, Primary productivity, Bacteria.

Surface and bottom samples were collected twice a month over a period of one year from three stations in Bayou Texar, Pensacola, Florida. Samples were analyzed for primary productivity, inorganic carbon, bacterioplankton heterotrophic productivity, dissolved glucose, and bacterial numbers. Dissolved glucose concentrations were generally high and displayed a seasonal pattern with variations being accompanied by corresponding changes in rates of glucose uptake by bacteria. A relationship between dissolved glucose and carbon fixation was found to exist at the upper station but diminishes toward the lower stations. It is believed that this is most likely the result of increased mixing by wind action. (Heany-Florida)  
W79-05397

#### INFLUENCE OF WASTE RESIDUALS IN ESTUARINE WATERS ON DEVELOPMENT, BEHAVIOR AND SURVIVAL OF SOFT-SHELL CLAM LARVAE.

Massachusetts University, Amherst. Department of Forestry and Wildlife Management. C. Gledhill, C. F. Cole, and C. Martin.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 606. Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center, University of Massachusetts, Publication No. 99, 1978. 37 p, 7 fig. 8 tab. 47 ref. OWRT A-111-MASS(1), 14-34-0001-8023.

Descriptors: Biological communities, Competition, \*Mollusks, \*Estuaries, \*Clams, \*Water pollution effects, Benthic fauna, Marine animals, Estuarine environment, Shellfish, *Mya arenaria*.

The effects of waste effluents on soft-shell clam (*Mya arenaria*) larval and spat survival were studied at one polluted and one unpolluted site. Soft-shell clam larval abundance in the plankton was determined at the two sites in 1977 and 1978, together with the temperature, salinity, and dissolved oxygen of the surface water. The two flats

were sampled in 1978 to obtain correlations between the infaunal species and soft-shell clams. Field experiments were conducted to determine the effect of one member of the infauna, *Gemma gemma*, on settlement of soft-shell clams. Significantly more larvae were found at the unpolluted site in 1977, but no differences in abundance occurred in 1978. Larval abundance was not correlated with temperature, salinity or dissolved oxygen. Sampling of the flats indicated negative correlations between soft-shell clams and the following species: *Gemma gemma*, *Hydrobia minuta*, *Drilonereis longa*, *Paranais fulgens*, and *Nereis diversicolor*, all of these species being more abundant at the polluted site. Field experiments showed a significant negative relationship between soft-shell clam settlement and high densities of gem clams. The study indicates the possibility that waste effluents can adversely affect recruitment of soft-shell clams by changing the biota to species detrimental to soft-shell clams.  
W79-05398

#### TOXICITY OF TREATED AND UNTREATED P. (PINUS) RADIATA TMP (THERMOMECHANICAL PULPING) EFFLUENTS ON A NUMBER OF ORGANISMS.

Gutteridge, Haskins and Davey (Pty) Ltd., Melbourne (Australia). R. T. Buckley. Appita, Vol. 32, No. 2, p. 129-133, September, 1978.

Descriptors: \*Pulp wastes, \*Toxicity, \*Aquatic life, \*Water pollution effects, Wastes, Industrial wastes, Water pollution sources, Pulp and paper industry, Effluents, Activated sludge, Waste water treatment, Pine trees, Aquatic animals, Fish, Aquatic insects, Aquatic plants, Mollusks, Foreign countries, Thermomechanical pulping, *Pinus radiata*, Australia.

Acute lethal and sublethal bioassay procedures were implemented at the request of Australian Newsprint Mills Ltd. to compare the toxicity of raw and activated sludge-treated *Pinus radiata* thermomechanical pulping effluents. Raw effluent was highly toxic at concentrations of 5-10% in clean water. The activated sludge process successfully eliminated this toxicity. Organisms included in the bioassay program were aquatic plants and insects, bivalve molluscs, and fish. (Swichtenberg-IPC)  
W79-05426

#### OBSERVATIONS ON HYPNOSPORES IN ULOTHRIX ZONATA (CHLOROPHYCEAE),

Miami Univ., Oxford, OH. Dept. of Botany. K. W. Bullock. Canadian Journal of Botany, Vol. 56, No. 14, p. 1660-1664, July 1978, 10 fig. 26 ref.

Descriptors: \*Hypnospores, \*Ulothrix zonata, \*Reproduction, \*Asexual reproduction, \*Plant growth, \*Cytological studies, \*Plant physiology, \*Plant morphology, Algae, Chlorophyta, Spores, Zoospores, Cytoplasm, Vegetative filaments, Termination, Electron microscopy.

The formation, structure, and development of hypnospores in the chlorophyte alga *Ulothrix zonata* are described, based on light and electron microscopy; the presence of hypnospores in this species represents a unique form of asexual reproduction among members of the genus *Ulothrix*. Hypnospores are formed by cleavages similar to those in zoosporegenesis, but not all of the parent cell cytoplasm is included in the hypnospores. The latter lack flagella or an eyespot, and possess a thick, dense cell wall (the pyrenoid), which together with the nuclear morphology of hypnospores, closely resemble vegetative cells. Production varies within an individual filament 2-4 large hypnospores per cell to as many as 32 smaller hypnospores per cell. Hypnospores are retained within the parent wall where they germinate into multicellular filaments. Subsequent growth of the filaments ruptures the parent cell wall, whereupon the filaments are released and settle on the substrate to continue growth. Recently released filaments are



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

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indistinguishable from those produced by zoospore germination or fragmentation of a vegetative filament. Hyphospores have previously been named parthenospores, microgonidia, and macrogonia, but none of these names accurately denote their formation and morphology. (Lynch-Wisconsin) W79-05428

**VARIABILITY OF ANNUAL NUTRIENT AND SEDIMENT DISCHARGES IN RUNOFF FROM OKLAHOMA CROPLAND AND RANGELAND**, Agricultural Research Service, Durant, OK. Water Quality Management Lab. R. G. Menzel, E. D. Rhoades, A. E. Olness, and S. J. Smith.

Journal of Environmental Quality, Vol. 7, No. 3, p. 401-406, July-September 1978. 4 fig, 4 tab, 23 ref.

**Descriptors:** \*Oklahoma, \*Ranges, \*Crop production, \*Nutrients, \*Sediments, \*Agricultural runoff, \*Water quality control, Pastures, Nitrogen, Phosphorus, Nitrates, Phosphates, Soil types, Chickasha(OK), Land use, Fertilization, Grazing, Cotton, Wheat, Watersheds(Basins), Farm management, Water pollution sources, Water pollution control, Rainfall, Soil erosion.

Annual variations in nutrient and sediment discharges may be as great as those due to different land uses or fertilizer additions, according to comparison of results from a four-year study (1972-76) of relationships between nutrient, water, and sediment discharges from cropland and rangeland in central Oklahoma with 1966-76 records of water and sediment discharges. Long historical records of a decade or more are therefore necessary to meaningfully evaluate treatments designed to control nutrient and sediment discharges. Average annual nutrient concentrations in runoff, though greatly variable, are reasonably predictable on the basis of runoff volume, sediment discharge, soil characteristics, and fertilization history. Six 5-18 ha watersheds near Chickasha, Oklahoma were studied; two were cropped continuously with cotton and two with wheat (all nearly level), and two were grazed at different intensities (3% slope). Average annual sediment discharge was 3600 kg/ha (8900 maximum) from irrigated cotton, 900 kg/ha (3900 maximum) from dryland wheat, 400 kg/ha (1800 maximum) from range with limited grazing, and 9000 kg/ha (23,000 maximum) from overgrazed range. Maximum annual nutrient discharges were 13 kg total N/ha, four kg nitrate-N/ha, 11 kg total P/ha, and two kg soluble P/ha. Average annual discharge for each nutrient was about half of these maximum values. (Lynch-Wisconsin) W79-05429

#### WATER CHLORINATION: ENVIRONMENTAL IMPACT AND HEALTH EFFECTS.

Volume 2, Proceedings of the Second Conference on the Environmental Impact of Water Chlorination, Gatlinburg, Tennessee, October 31-November 4, 1977. Jolley, R.L., Gorchev, H and Hamilton, D.H., Jr. (Eds.). Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1978. 909 p.

**Descriptors:** \*Conferences, \*Chlorination, Environmental effects, Public health.

The conference proceedings contains 66 papers related to the subject of water chlorination and 6 workshop and conference summaries. Areas of interest include chemistry of freshwater systems, environmental effects in freshwater systems, chemistry of marine systems, environmental effects in marine systems, health effects, drinking water treatment, wastewater treatment and alternatives to chlorination, cooling water treatment and alternatives to chlorination, industrial effluents, and regulations concerning the practice of chlorination. (See W79-05436 thru W79-05495) (Chilton-ORNL) W79-05435

#### NATURAL AND MODEL AQUATIC HUMICS: REACTIONS WITH CHLORINE,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering. R. F. Christman, J. D. Johnson, J. R. Haas, F. K.

Pfander, and W. T. Liao.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H. and Hamilton, D.H., Jr. (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 15-28, 1978 6 fig, 2 tab, 17 ref.

**Descriptors:** \*Environmental effects, \*Water pollution, \*Chlorination, Freshwater, Chemistry, Analytical techniques.

This report summarizes initial findings of a study which includes the isolation, concentration and chemical degradation of natural humic material and the controlled laboratory reaction of phenolic model compounds with chlorine. From a 500 gal. sample of lake water, humic material was isolated and concentrated to 20 liters of humic-hymatomelanic fraction and 10 liters of fulvic acid fraction. Elemental analysis of further purified humic-hymatomelanic acid solids revealed a C:H:O:N ratio of 1.0:1.17:0.61:0.05. Products of degradation of humic-hymatomelanic acid are listed. The only model compound chlorination investigation reported was resorcinol. Chloroform production was measured at various resorcinol concentrations and it was noted that as the C/C ratio increased, relative chloroform production increased linearly up to a ratio value of 1.14 + or - 0.09. Data indicated that free residual chlorine exists beyond this value. GC/MS analysis of ether extracts of reaction mixtures before the endpoint revealed the presence of a cyclopentene derivative which increased in concentration as the concentration of resorcinol increased and is believed to be the principal product formed in addition to chloroform. The cyclopentene disappears at the reaction endpoint. No other nonpolar products were detected past the endpoint. (See also W79-05435) (Chilton-ORNL) W79-05437

#### AQUEOUS CHLORINATION OF SOME PHENOLIC ACIDS.

Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center. A. L. Rockwell, and R. A. Larson.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr. (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 67-74, 1978 2 fig, 16 ref.

**Descriptors:** \*Chlorination, \*Water pollution, Freshwater, Chemistry, Water chemistry, Phenols.

An investigation of the formation of chlorophenols from chlorination of waters containing phenolic acids is reported. Aqueous chlorination and decarboxylation of aromatic acids occurred in two steps. Addition of chlorine from hypochlorite to an aromatic ring was electrophilic and thus favored by electron-donating substituents. In decarboxylation an intermediate with a negative charge is generated. Delocalization of this charge by resonance to the aromatic carbon atoms ortho to the phenolate group is favored by electron-withdrawing substituents. Kinetic data and product analyses are in accord with the proposed mechanism. (See also W79-05435) (Chilton-ORNL) W79-05441

#### A PROGRAM TO INTRODUCE SITE-SPECIFIC CHLORINATION REGIMES AT ONTARIO HYDRO GENERATING STATIONS,

Ontario Hydro, Toronto. J. A. Grieve, L. E. Johnston, T. G. Dunstall, and J. Minor.

In: Water Chlorination, Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H. and Hamilton, D.H., Jr. (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 77-94, 1978 14 fig, 13 ref.

**Descriptors:** \*Environmental effects, \*Chlorination, Water pollution, Analytical techniques, Fish, White bass, Discharge(Water), Sites, Stations.

The purpose of this study was to develop site-specific chlorination regimes which would opti-

mize station efficiency compatible with its operating mode while ensuring environmental stability. Parameters considered were chlorine plume (size and decay), effect of chlorine discharges on fish (specifically white bass), and analytical methods for determination of low chlorine concentrations. Dilution in the outfall channel and dispersion and reaction in the plume resulted in rapid decay in chlorine concentration. Extent of the chlorine plume could be calculated to a first approximation by using site-specific chlorine reaction factors. Fish movement studies showed that white bass take avoidance action during short-term chlorination in excess of 35 microg/l. Acceptable total residual chlorine level was between 35 microg/l and 50 microg/l in the outfall channel. Evaluation of analytical technique showed that Orion potentiometric and the Delta scientific method were not as sensitive or accurate as the Princeton applied research method. (See also W79-05435) (Chilton-ORNL) W79-05442

#### A PRELIMINARY LOOK AT THE EFFECTS OF INTERMITTENT CHLORINATION ON SELECTED WARMWATER FISHES,

Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies; and Wisconsin Univ.-Milwaukee. Dept. of Zoology.

A. S. Brooks, and G. L. Seeger.

In: Water Chlorination, Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H. and Hamilton, D.H., Jr. (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 95-109, 1978. 5 tab, 19 ref.

**Descriptors:** \*Environmental effects, \*Chlorination, \*Fish, Water pollution, Freshwater fish, Carp, Sunfishes, Shiners, Mortality, Fish behavior.

Five species of freshwater fish (emerald shiner, Notropis antherinoides; common shiner, Notropis cornutus; spotfin shiner, Notropis spilopterus; bluegill, Lepomis macrochirus; and carp, Cyprinus carpio) were tested for their resistance to quadruple 40-min exposures of monochloramine. All species were lethargic during exposure but usually behaved normally between exposures with this behavior being especially pronounced in carp. Mortalities occurred most rapidly in spotfin and emerald shiners, were intermediate in common shiner and carp and slowest in bluegill. Mucus loss was a general response in all five species with the degree of occurrence being influenced by exposure time, concentration, chlorine form and fish species. All five species tested showed an inverse relationship between temperature and resistance to monochloramine. (See also W79-05435) (Chilton-ORNL) W79-05443

#### TOWARD AN UNDERSTANDING OF THE TOXICITY OF INTERMITTENT EXPOSURES OF TOTAL RESIDUAL CHLORINE TO FRESHWATER FISHES,

Oregon State Univ., Corvallis. Oak Creek Lab. of Biology.

G. L. Larson, and D. A. Schlesinger.

In: Water Chlorination, Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr. (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 111-122, 1978. 4 fig, 1 tab, 9 ref.

**Descriptors:** \*Environmental effects, \*Chlorination, \*Fish, Water pollution, Freshwater fish, Bass, Largemouth bass, Toxicity.

Acute toxicity, and the effect of temperature on acute toxicity, on largemouth bass of total residual chlorine at different concentrations, exposure durations and frequencies was evaluated. Groups of largemouth bass were exposed to high-spike pattern of exposure, low-spike pattern of exposure and square pattern of exposure. Relationships between mortality and the area under the time-concentration exposure curve were not significantly different for the three patterns. Intervals between exposures were only two hours for fish receiving two 90-min exposures and this was not enough time for recovery. Temperature was shown to influence toler-

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ance with fish being more tolerant at 13.1 C than at 24.3 C. It was concluded that sudden increase in temperature over acclimation temperature decreases the tolerance of fish to residual chlorine compounds. (See also W79-05435) (Chilton-ORNL) W79-05444

#### INFLUENCE OF CHLORINE FORM AND AMBIENT TEMPERATURE ON THE TOXICITY OF INTERMITTENT CHLORINATION TO FRESHWATER FISH.

Virginia Polytechnic Inst. and State Univ., Blacksburg, Dept. of Biology.

A. G. Heath.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H., and Hamilton, D.H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 123-133, 1978 6 fig, 2 tab, 9 ref.

Descriptors: \*Environmental effects, \*Water pollution, \*Chlorination, Temperature, Fish, Mortality, Toxicity, Freshwater, Trout, Salmon, Sunfishes, Shiners, Channel catfish.

Bioassays using death as the endpoint were conducted on rainbow trout, coho salmon, golden shiner, bluegill and channel catfish which had been exposed to intermittent chlorination at various temperatures. At median lethal concentrations, there was a slight temperature effect on free chlorine toxicity to rainbow trout, bluegill and channel catfish and a greater effect on golden shiners. Temperatures in the middle of the tolerance, one caused a slightly greater sensitivity to chlorine in trout and bluegills. No significant differences in LC50 values at different temperatures for monochloramine pulses were observed in salmon or catfish. Shiners exhibited an inverse temperature effect for monochloramine pulses. 0.5 mg/l TRC (total residual chlorine) with 0.38 mg/l free chlorine resulted in 50% death with only one chlorination pulse but a chloramine pulse of 0.5 mg/l with no free chlorine gave an LT50 of 40 pulses. A 3.3-4.5 fold difference in TRC LC50 values was found between free chlorine and monochloramine doses in trout, coho and golden shiners. Channel catfish showed greater sensitivity to chloramine than other species but were still less affected by chloramine than free chlorine. (See also W79-05435) (Chilton-ORNL) W79-05445

#### THE USE OF VARIOUS AVOIDANCE INDICES TO EVALUATE THE BEHAVIORAL RESPONSE OF THE GOLDEN SHINER TO COMPONENTS OF TOTAL RESIDUAL CHLORINE.

Virginia Polytechnic Inst. and State Univ., Blacksburg, Dept. of Biology; and Virginia Polytechnic Inst. and State Univ., Blacksburg, Center for Environmental Studies.

S. R. Larrick, D.S. Cherry, K. L. Dickson, and J. Cairns, Jr.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H., and Hamilton, D.H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 135-147, 1978. 4 fig, 1 tab, 24 ref.

Descriptors: \*Environmental effects, \*Chlorination, Fish behavior, Shiners, Temperature, Fish, Water pollution, Avoidance response, Acclimation temperature.

The objectives of this study were to evaluate standardized methods and indices for chlorine avoidance investigations; to determine if avoidance behavior is correlated with a specific component of the total residual; and to evaluate the influence of acclimation temperature on avoidance behavior by golden shiners. Total residual chlorine (TRC), free residual chlorine (FRC), and combined residual chlorine (CRC) avoidance thresholds varied with acclimation temperature, being similar at 12, 18 and 30C and maximal at 24C. HOCl avoidance thresholds were consistent with acclimation temperature, varying from 0.015-0.017 mg/l. It was concluded that the hypochlorous acid fraction of

the total residual chlorine directs golden shiner chlorine avoidance behavior. (See also W79-05435) (Chilton-ORNL) W79-05446

#### AVOIDANCE OF MONOCHLORAMINE: TEST TANK RESULTS FOR RAINBOW TROUT, COHO SALMON, ALEWIFE, YELLOW PERCH AND SPOTTAIL SHINER.

WAPORA, Inc. Washington, DC.

R. B. Bogardus, D. B. Boies, T. C. Teppen, and F. J. Horvath.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H., and Hamilton, D. H., Jr., (Eds.). Proceedings of Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 149-161, 1978. 2 fig, 7 ref.

Descriptors: \*Environmental effects, \*Chlorination, \*Water pollution, Fish, Fish behavior, Trout, Salmon, Shiners, Yellow perch, Chlorine, Toxicity, Schools(Fish), Avoidance response.

All species tested in this study showed a tendency toward increasing avoidance as the concentration of monochloramine was gradually increased. All species exhibited either schooling or gregarious behavior which was important in the avoidance response of the species. Distress signs were occasionally observed in all species but no deaths occurred during testing. Juvenile coho salmon exhibited territoriality which had important ramifications upon their avoidance response. It was concluded that avoidance is a characteristic of chlorine toxicity in combination with level of detection, conditioned or learned response and acclimation, and cannot be relegated to a rigid, precise code of behavior. (See also W79-05435) (Chilton-ORNL) W79-05447

#### INVESTIGATION OF THE EFFECTS OF HALOGENATED ORGANIC COMPOUNDS PRODUCED IN COOLING SYSTEMS AND PROCESS EFFLUENTS ON AQUATIC ORGANISMS.

Oak Ridge National Lab., TN. Environmental Sciences Div.

J. R. Trabalka, and M. B. Burch.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H., and Hamilton, D.H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 163-173, 1978. 4 tab, 18 ref.

Descriptors: \*Environmental effects, \*Water pollution, \*Chlorination, Freshwater, Toxicity, Carp, Embryonic growth stage, Daphnia, Sewage effluents, Cooling water, Chlorophenol.

Tests were conducted for three synthetic effluents based on identifications from sewage effluent and cooling waters. Embryos of carp (*Cyprinus carpio*) and the cladoceran (*daphnia pulex*) were used in the studies. Results of tests on carp embryos showed a trend in comparative toxicity (LC50 for secondary sewage effluent < Mississippi River cooling water < Watts Bar Reservoir cooling water). 96-hr LC50 values for *Daphnia pulex* exposed to the effluents showed toxicity of the synthetic secondary sewage effluent > Mississippi River cooling water > Watts Bar Reservoir cooling water. It was concluded that the toxicity of the chloro-organics tested was primarily attributable to its chloro-phenol content and that acute toxicity was demonstrable in the carp embryo and *Daphnia pulex* at levels approximately three orders of magnitude greater than those expected in actual effluents. (See also W79-05435) (Chilton-ORNL) W79-05448

#### BROMINATED COMPOUNDS FOUND IN WASTE-TREATMENT EFFLUENTS AND THEIR CAPACITY TO BIOACCUMULATE.

Environmental Research Lab., Duluth, MN.

D. W. Kuehl, G. D. Veith, and E. N. Leonard.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H., and Hamilton, D.H. Jr. (Eds.). Proceedings of Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 175-192, 1978 6 fig, 3 tab, 17

ref.

Descriptors: \*Environmental effects, \*Water pollution, \*Chlorination, Bromine, Water treatment, Disinfection, Fish, Absorption, Bioaccumulation.

Fathead minnows exposed to bromine-chloride-treated and nondisinfected effluent were analyzed. This analysis resulted in the isolation and identification of a series of brominated phenols, anisoles and heterocyclic and heterocyclic aromatics. Although the organobromine residues were observed at concentrations at least an order of magnitude less than the toxic chemicals such as PCB and chlordane that were present in the raw wastes, the smaller bioconcentration factors for the polar brominated chemicals suggest that measurable water concentrations of these chemicals are likely to be present in chlorobrominated wastewater. It was recommended that the aqueous chemistry of bromination of organic chemicals and measurement of the products in wastewaters be studied to determine if chlorobromination is more advantageous than chlorination with respect to the halogenated chemicals produced. (See also W79-05435) (Chilton-ORNL) W79-05449

#### REACTIONS IN CHLORINATED SEAWATER.

Rosenstiel School of Marine and Atmospheric Science, Miami, FL.

For primary bibliographic entry see Field 5A.

W79-05450

#### DDT, PCB AND CHLORINATED BENZENES IN THE MARINE ECOSYSTEM OFF SOUTHERN CALIFORNIA.

Southern California Coastal Water Research Project, El Segundo.

D. R. Young, and T. C. Heesen.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H., and Hamilton, D.H., Jr. (Eds.). Proceedings of a Conference, Gatlinburg, Tennessee, October 31-November 4, 1977, p 267-290, 1978. 5 fig, 6 tab, 29 ref. EPA R 803707.

Descriptors: \*Chlorination, \*Water chemistry, Chlorine, Chlorinated hydrocarbon pesticides, DDT, Polychlorinated biphenyls, Environmental effects, Water pollution, Waste water(Pollution), Sediments, Fish.

Findings on DDT and PCB inputs, distributions and impacts are compared with results on chlorinated benzenes in the same ecosystem. DDT, PCB and chlorinated benzene concentrations in flat fish residing near a major municipal outfall were related to concentration of these compounds in the sediments. Contamination of sediments by DDTs and PCBs was seen to result in persistent contamination of marine organisms after major reductions in dominant inputs occurred. DDT residues of >5 ppm in bottom feeding fish appear to have caused deaths of captive marine birds feeding on these fish for more than a year. Unchlorinated municipal wastewaters were the dominant source of chlorinated benzenes in the Bight. Differences between input rates of DDT, PCB and chlorinated benzenes and concentration of corresponding compounds present in resident fish are partially explained by higher inputs of DDT and PCB residues in the past. High solubilities and bio-accumulation factors are also of importance. (See also W79-05435) (Chilton-ORNL) W79-05455

#### BIOLOGICAL AND CHEMICAL EFFECTS OF CHLORINATION AT COASTAL POWER PLANTS.

Woods Hole Oceanographic Institution, MA.

J. C. Goldman, J. M. Capuzzo, and G. T. F.

Wong.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R.L., Gorchev, H., and Hamilton, D.H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 291-305, 1978. 8 fig, 10 ref. ERDA E(11-1)-2552.



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

Descriptors: \*Environmental effects, \*Water pollution, \*Chlorination, Sea water, Powerplants, Coasts, Phytoplankton, Zooplankton, Larval growth stage, Chemistry.

This report reviews research findings and offers recommendations on chlorination practice at coastal power plants. The complexity of the chemistry of chlorine in sea water is discussed and concern is expressed over the potential toxicity of unidentified compounds. It was concluded that chlorination effects on larval zooplankton at power plants is more serious than effects on phytoplankton. Growth rates of some commercially important species were found to be seriously retarded after exposure to sublethal chlorine concentrations while phytoplankton growth rates of recovered cells did not appear to be permanently affected. It was suggested that the practice of dechlorination immediately after entrainment should be considered. (See also W79-05435) (Chilton-ORNL) W79-05456

#### TOXICITY SCREENING OF FIFTEEN CHLORINATED AND BROMINATED COMPOUNDS USING FOUR SPECIES OF MARINE PHYTOPLANKTON

Environmental Protection Agency, Gulf Breeze, FL.; and Environmental Research Lab., Johns Island, SC. Bears Bluff Field Station. S. J. Erickson, and A. E. Freeman.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 307-310, 1978. 1 tab, 3 ref.

Descriptors: \*Chlorination, \*Toxicity, Algae, Sea water, Marine algae, Environmental effects, Water pollution, Phytoplankton.

The toxicity screening tests investigated in this work were performed on *Skeletonema costatum*, *Thalassiosira pseudonana*, *Glenodinium halli*, and *Isochrysis galbana*. The concentration of test compounds which inhibited or stimulated cell division were determined and are presented in tables. All four species of algae responded to the compounds in a like manner. Monochloramine was the most inhibitory compound tested. Halogenated phenols gave varied responses. At the concentrations tested, p-chlorophenol and 2,4,6-tribromoisole yielded no toxic effects. Five compounds were growth inhibitory (p-bromophenol < 2,4,6-tribromoisole < 2,4,6-trichlorophenol < pentachlorophenol < pentabromophenol). Pentachlorophenol and pentabromophenol were highly inhibitory. The halogenated hydrocarbons were all stimulatory to the algae. (See also W79-05435) (Chilton-ORNL) W79-05457

#### SEASONAL CHRONIC TOXICITY OF CHLORINATION TO THE AMERICAN OYSTER, CRASSOSTREA VIRGINICA (G.)

Environmental Protection Agency, Gulf Breeze, FL.; and Environmental Research Lab., Johns Island, SC. Bears Bluff Field Station. G. I. Scott, and D. P. Middaugh.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 311-328, 1978. 7 fig, 3 tab, 22 ref.

Descriptors: \*Environmental effects, \*Chlorination, Water pollution, Oysters, Toxicity, Seasonal, Mortality, Temperature, Feeding.

In order to assess the effects of chronic exposure of oysters to chlorination the following measurements were made: daily percentage survival; shell height prior to and at the end of each seasonal exposure; growth; and condition index as determined by the Galtsoff method. Results indicated that chronic exposures of *C. virginica* to chlorine-produced oxidant (CPO) products can produce considerable mortality at high concentrations and severe sublethal effects at lower levels. Toxicity is related to

seasonal changes in measured CPO concentrations, temperature and the physiological condition of the oyster. Sublethal effects appeared to be related to reductions in feeding and increased avoidance of CPO. This resulted in reduced tissue production causing severe reductions in the size of gonadal tissues as well as increased dependence upon glycogen reserves during exposures to CPO. (See also W79-05435) (Chilton-ORNL) W79-05458

#### EFFECTS OF CHLORINATED SEA WATER ON DECAPOD CRUSTACEANS

Virginia Inst. of Marine Science, Gloucester Point. M. H. Roberts, Jr.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 329-339, 1978. 4 fig, 3 tab, 2 ref. EPA R 803872-01 & R 803872-02.

Descriptors: \*Environmental effects, \*Chlorination, Water pollution, Crabs, Embryonic growth stage, Larvae, Toxicity, Seasonal, Resistance.

Eggs and larvae of *Panopeus herbstii* and *Pagurus longicarpus* were exposed to reasonably uniform concentrations of chlorine-induced-oxidants (CIO) in a continuous flow system. Data indicated *Panopeus herbstii* eggs were more tolerant of CIO than larvae. Larvae of both species were more sensitive than adults. Zoal stages have a relatively poorly calcified exoskeleton which is more permeable than the egg membrane and larvae are especially sensitive to toxicants during molting. It was noted that there is an apparent seasonal change in the acutely toxic dose for *P. herbstii* zoeae, with larvae produced late in the normal breeding season being more sensitive than those produced during the rest of the breeding season. (See also W79-05435) (Chilton-ORNL) W79-05459

#### THE RELATIVE SENSITIVITY OF PACIFIC NORTHWEST FISHES AND INVERTEBRATES TO CHLORINATED SEA WATER

Battelle Pacific Northwest Labs. Sequim, WA. Marine Research Labs. T. O. Thatcher.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, TN., p 341-350, 1978. 1 tab, 20 ref. ERDA EY-76-C-06-1830.

Descriptors: \*Environmental effects, \*Chlorination, Water pollution, Sea water, Toxicity, Fish, Invertebrates, Mortality.

The relative sensitivity of 8 fish and 7 invertebrate species to chlorinated sea water was determined using a series of 96-hr LC50 continuous flow bioassays. Fish were generally more sensitive than invertebrates. Three rather distinct groups with differing sensitivity were observed. The most sensitive group (exhibiting 96-hr LC50 values from 0.026 mg/l total residual oxidant (TRO) up to 0.119 mg/l TRO) included 3 salmon species, Pacific herring, shiner perch, English sole, Pacific sand lance and *Pandalus goniurus*. Intermediate sensitivity (96-hr LC50 values ranging from 0.118 mg/l TRO to 0.199 mg/l TRO) was shown by *Crangon nigricauda*, amphipod (*Anonyx* sp.), mysid (*Neomysis* sp.) threespine stickleback, and coon stripe shrimp. The most resistant group (96-hr LC50 values ranging from 0.583 mg/l TRO to 1.530 mg/l TRO) consisted of two invertebrates, the amphipod (*Pontogonia* sp.) and shore crab (*Hemigrapsus nudus* and *H. oregonensis*). It was observed that for all species tested suggesting that the same mechanism of toxicity is producing mortality. (See also W79-05435) (Chilton-ORNL) W79-05460

#### RESPIRATORY AND OSMOREGULATORY RESPONSES OF WHITE PERCH (MORONE

#### AMERICANA) EXPOSED TO CHLORINE AND OZONE IN ESTUARINE WATERS

Tetra Tech, Inc. Lafayette, CA. R. M. Block, D. T. Burton, S. R. Guillans, and L. B. Richardson.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 351-360, 1978. 2 tab, 10 ref. EPA R 804683010 and Md. Power Plant Siting Prog. 25-75-04(77).

Descriptors: \*Chlorination, \*Environmental effects, Water pollution fish, White perch, Chlorine, Ozone, Respiration, Animal physiology, Mortality.

One of the most striking results of these investigations into the relative toxicity of chlorine and ozone to white perch was that all fish exposed to ozone died shortly after 6 hours of exposure while no mortality was observed until after 8 hours in fish exposed to chlorine. Histological studies showed pathological damage to gill tissue from both ozone and chlorine exposure. It was concluded that the mode of action of both toxicants is the same in that osmoregulatory and respiratory mechanism are affected in the same manner. Blood pH and plasma osmolality are identified as sensitive indicators of oxidant stress. (See also W79-05435) (Chilton-ORNL) W79-05461

#### CONTINUOUS LOW-LEVEL CHLORINATION FOR MARINE FOULING CONTROL AT POWER STATIONS IN THE UNITED KINGDOM

Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.

J. W. Whitehouse.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, TN., p 361-367, 1978. 6 tab, 2 ref.

Descriptors: \*Environmental effects, \*Chlorination, \*Water pollution, Mussels, Cooling water, Mortality, Chlorine, Intakes, Screens, Iron.

This paper describes experiments using *Mytilus edulis* L. as the test organism with ferrous sulfate-treated sea water and studies of intake screen debris which assess the extent of fouling control. Data from batch-treated experiments indicated that ferrous sulfate depressed foot activity and byssus production in *M. edulis* by comparison with untreated water. Long-term experiment on byssus thread production showed that ferrous sulfate did not reduce the counts of threads/animal/day by comparison with untreated animals and there was no significant difference in thread production between treatments. Examination of screen washing debris showed that at the start-up of chlorination in the spring, 400 starfish of 20-200 mm size were caught on the screens within an hour of venting chlorine. A similar number were caught the following day when continuous schedule was begun but debris examined 3 months later revealed no starfish in a 13-hr sampling period. Mussels collected in spring were nearly all empty shell. Live mussels were found in the debris in summer suggesting that a thriving population exists within the cooling tunnels. (See also W79-05435) (Chilton-ORNL) W79-05462

#### RESPONSE OF ENTRAINED PLANKTON TO LOW-LEVEL CHLORINATION AT A COASTAL POWER STATION

Central Electricity Generating Board, Southampton (England). Marine Biological Lab.; and Central Electricity Generating Board, Fawley (England). Fawley Power Station.

M. H. Davis, and J. Coughlan.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlin-

## Effects Of Pollution—Group 5C

burg, TN., p 369-376, 1978. 1 fig, 2 tab, 16 ref.

Descriptors: \*Environmental effects, \*Chlorination, Plankton, Cooling water, Chlorine, Mortality, Photosynthesis, Nuclear powerplants.

This paper reports field investigations of the side effects of chlorination on plankton pumped through the cooling system of a nuclear power station. Adult copepods, copepod and barnacle nauplii comprised 95% of the samples taken. Immediate mortality of these three groups was low; 48 hrs later mortality increased, particularly at chlorine concentrations above 0.5 ppm. Depression of photosynthetic activity increased with chlorine concentration, reaching 95% at 1.0 ppm. The 3-hr EC50 (effective initial concentration for 50% reduction in productivity) was 0.09 ppm. Bacterial activity virtually ceased when chlorination was in progress. It was concluded that side effects of chlorination on phytoplankton warrant further investigation. (See also W79-05435) (Chilton-ORNL) W79-05463

#### THE EPIDEMIOLOGIC APPROACH TO THE EVALUATION OF ORGANICS IN DRINKING WATER.

Environmental Protection Agency, Cincinnati, OH.

K. P. Cantor, and L. J. McCabe.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 379-391. 1978. 3 tab, 23 ref.

Descriptors: \*Chlorination, \*Public health, \*Epidemiology, Water pollution, Reviews, Water pollution effects, Human diseases.

This paper reviews the background against which current studies on the epidemiologic method as applied to the evaluation of health risks of waterborne carcinogens will be reviewed and suggests directions for future research. Problems involved in epidemiologic methods are discussed and individual studies are reviewed. (See also W79-05435) (Chilton-ORNL) W79-05464

#### A CASE CONTROL STUDY OF GASTROINTESTINAL AND URINARY TRACT CANCER MORTALITY AND DRINKING WATER CHLORINATION.

Hunter Coll., New York. School of Health Sciences.

M. Alavanja, I. Goldstein, and M. Susser.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 395-409. 1978. 6 tab, 7 ref.

Descriptors: \*Chlorination, \*Environmental effects, \*Public health, Disease, Water pollution, Water pollution effects, Water pollution sources, Human diseases, Mortality, New York.

In this study a total of 3446 gastrointestinal and urinary tract cancer mortalities and 3444 individually matched controls were analyzed. Inadequate water quality data in the seven counties represented in the study prevented the making of a definitive claim that chlorination was directly or indirectly responsible for the greater risk of cancer mortality in chlorinated water areas. The following conclusions were drawn: Males living in chlorinated water areas of Erie, Rensselaer and Schenectady counties (N.Y. state) and females living in the chlorinated water areas of Erie and Schenectady counties are at a greater risk of gastrointestinal and urinary tract cancer mortality than are individuals living in nonchlorinated water areas. This excess risk of GI and UT cancer is not due to a disparity in the age, race, or ethnic distribution of the population or to an urban/rural factor, hazardous occupation, inorganic carcinogens or a surface/ground water difference. (See also W79-05435) (Chilton-ORNL) W79-05465

#### MUTAGENICITY AND WATER CHLORINATION: PROSPECT AND PERSPECTIVE.

Oak Ridge National Lab. TN.

R. B. Cumming.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 411-416. 1978. 6 ref.

Descriptors: \*Chlorination, \*Public health, Environmental effects, Water pollution, Water pollution effects, Water pollution sources, Human diseases, Genetics.

This paper presents an overview of mutagenicity and mutagenicity tests and the extent to which they are relevant to the assessment of water chlorination's impact on public health. The areas discussed include genetic toxicology, the relationship between mutagenesis and carcinogenesis, and the indirect health effects on humans of mutation and selection processes. It was concluded that mutagenesis is a difficult area to put into perspective due to the fact that there are too many loose ends in the field. Data shows that it is, however, an important toxicological end point. (See also W79-05435) (Chilton-ORNL) W79-05466

#### THE MUTAGENIC ACTIVITY OF HALOGENATED COMPOUNDS FOUND IN CHLORINATED DRINKING WATER.

SRI International, Menlo Park, CA.

V. F. Simmon, and R. G. Tardiff.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, TN., p 417-431. 1978. 16 fig, 20 ref. EPA 68-03-11-74.

Descriptors: \*Chlorination, \*Public health, Potable water, Water pollution sources, Water pollution, Human diseases, Genetics, Environmental effects.

In this study, 22 halogenated compounds were assayed for mutagenic activity by the Ames Salmonella/microsome procedure. Although CCl<sub>4</sub> and CHCl<sub>3</sub> are recognized carcinogens in rodents, the investigators were unable to establish a dose-dependent or time dependent increase in the number of mutants. Known carcinogens that were mutagenic were vinyl chloride, vinylidene chloride, 1,2-dichloroethane, 1,1,2-trichloroethylene, bis(2-chloroethyl) ether, methyl iodide, and bromoform. Bromodichloromethane and chlorodibromomethane, which have not been tested for carcinogenic activity, were found to be mutagenic. The halomethanes were all mutagenic. Within each class of chemicals, mutagenic activity was proportional to chemical reactivity. It was concluded that the high correlation between chemicals that are mutagenic and carcinogenic and the evidence that mutagens are deleterious indicate that the number and amount of alkyl halides in potable water should be reduced. (See also W79-05435) (Chilton-ORNL) W79-05467

#### MUTAGENICITY OF COMPLEX MIXTURES FROM DRINKING WATER.

Cincinnati Univ., OH. Dept. of Microbiology.

J. C. Loper, D. R. Lang, and C. C. Smith.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 433-450. 1978. 6 fig, 6 tab, 12 ref. EPA R804-020.

Descriptors: \*Chlorination, \*Public health, Environmental effects, Water pollution, Water pollution sources, Human diseases, Genetics, Potable water.

Samples of organic residues isolated from drinking water by the reverse osmosis procedure were assayed for their mutagenic activity. This study clearly indicates that these residues produce muta-

genesis in Salmonella tester strains. The residues and subfractions from water of different cities show city-specific patterns which are relatively stable form samples taken at 2 - 3 month intervals. Indications of mutagenic or carcinogenic activity in these mixtures can be compared with similar data being generated with known constituents of drinking water to make possible the detection of comutagenic, cocarcinogenic or antagonistic activities of components in the mixtures. (See also W79-05435) (Chilton-ORNL) W79-05468

#### A PRIORI PREDICTIVE METHODS OF ASSESSING HEALTH EFFECTS OF CHEMICALS IN THE ENVIRONMENT.

California Univ., Berkeley. Lawrence Berkeley Lab.

M. J. Kland.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 451-469. 1978. 7 fig, 2 tab, 23 ref.

Descriptors: \*Chlorination, \*Public health, Environmental effects, Water pollution, Chemicals, Chemical wastes, Forecasting.

Four techniques (structure/activity relationships (SAR), factor analysis (FA), pattern recognition (PR), and molecular connectivity (MC)) for assessing the multifactorial problems of toxicity and carcinogenicity are described. It was concluded that none of these techniques provides easy answers but that PR and MC both merit more intensive investigation as predictive tools. (See also W79-05435) (Chilton-ORNL) W79-05469

#### DEVELOPMENT OF RESISTANT POLIOVIRUS BY REPETITIVE SUBLETHAL EXPOSURE TO CHLORINE.

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.

R. C. Bates, S. M. Sutherland, and P. T. B. Shaffer.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 471-482. 1978. 5 fig, 1 tab, 14 ref.

Descriptors: \*Chlorination, \*Public health, Water pollution, Water pollution sources, Chlorine, Resistance, Viruses, Genetics.

The studies reported here indicate that a laboratory strain of poliovirus can be made more resistant to chlorine inactivation by a procedure which either selects for a resistant subpopulation of the parental population or by a direct mutagenic action of the halogen on the virus to produce a resistant variant. Not only does the virus develop increased resistance to chlorine inactivation but other phenotypic characteristics such as plaque size and morphology change, indicating the possibility that increased resistance to chlorine inactivation could be accompanied by genetic changes which alter the virulence of the virus for the natural host. (See also W79-05435) (Chilton-ORNL) W79-05470

#### EPIDEMIC PROBLEMS AND CHLORINATION OF DRINKING WATER AND SEWAGE IN THE FEDERAL REPUBLIC OF GERMANY.

Bundesgesundheitsamt, Berlin (Germany, F.R.).

Inst. fuer Wasser-, Boden-, und Lufthygiene.

G. Muller.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 483-492. 1978. 3 fig, 8 ref.

Descriptors: \*Chlorination, \*Water pollution, \*Public health, Epidemics, Water pollution effects,



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

Environmental effects, Human diseases, Epidemiology.

This paper reviews the history of epidemics transmitted through drinking water in Germany and discusses the advantages of disinfection through chlorination. Because of the association of bacterial disease and epidemics with the use of raw river water for drinking purposes, ground water from underground aquifers is used for drinking water production. Water treatment and supply technique are not uniform but vary depending upon the chemical and biological conditions of the raw water. Chlorination varies from town to town and from region to region. It is stated that drinking water disinfection by chlorination was a decisive factor in combating infectious waterborne epidemic outbreaks but that the advantage of chlorination may be partially offset by the potential health hazards of noninfectious agents. (See also W79-05435) (Chilton-ORNL)

W79-05471

#### WORLDWIDE ASPECTS OF WATER CHLORINATION.

World Health Organization, Geneva (Switzerland). Div. of Environmental Health.

L. A. Oriuela, R. C. Ballance, and R. Novick.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 493-507. 1978. 6 ref.

Descriptors: \*Environmental effects, \*Water pollution, Public health, Water quality, Chlorination, Water supply.

This paper reviews the use of disinfectants for drinking water on a worldwide basis and the present global water supply situation. It was concluded that the severe and pervasive deficiencies in water supply are beginning to receive attention commensurate to their importance at both national and international levels of government. The recommendations on community water supply of the United Nations Water Conferences are presented. (See also W79-05435) (Chilton-ORNL)

W79-05472

#### RISK ASSESSMENT OF THE HEALTH EFFECTS OF WATER CHLORINATION.

National Cancer Inst., Bethesda, MD.

M. Schneiderman.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 509-515. 1978. 1 fig, 8 ref.

Descriptors: \*Environmental effects, \*Water pollution, \*Chlorination, Public health, Water quality, Human diseases.

This paper discusses the complexities of determining risk assessments related to health effects of water chlorination. The chemical interactions of chlorine with substances present in water are discussed. Quantitative relationships is identified as a major need of regulatory agencies. (See also W79-05435) (Chilton-ORNL)

W79-05473

#### CHLORINATION AND WATER TREATMENT FOR MINIMIZING TRIHALOMETHANES IN DRINKING WATER.

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.

R. C. Hoehn, C. W. Randall, R. P. Goode, and P. T. B. Shaffer.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, TN, p 519-535. 1978. 6 fig, 2 tab, 29 ref. EPA 68-01-3202.

Descriptors: \*Chlorination, \*Water chemistry, Environmental effects, Water quality, Water pollution.

The objectives were to show the effectiveness of powdered activated carbon (PAC) for reducing finished water trihalomethane (THM) concentrations when used in conjunction with routine water treatment (including chlorination) of a simulated surface water containing humic acids and to discuss experimental results. PAC of the type used in this study was found to be only minimally effective in reducing THM concentrations in finished waters. Coagulation with ferric sulfate, followed by flocculation and sedimentation, accounted for the majority of the reductions seen in THM concentrations. THM concentrations in finished water correlated directly with the extent of algae growth. It was recommended that the potential use of PAC for reducing organics should not be discounted on the basis of this study. Other THM precursors, intermediates in the haloform reaction, and hazardous organics may be effectively removed by PAC. Pre-disinfection is recommended when surface waters are contaminated by urban runoff and sewage discharges. (See also W79-05435) (Chilton-ORNL)

W79-05474

#### FORMATION AND OCCURRENCE OF HALOFORMS IN DRINKING WATER IN THE FEDERAL REPUBLIC OF GERMANY.

Bundesgesundheitsamt, Berlin (Germany, F. R.). Inst. fuer Wasser-, Boden-, und Lufthygiene.

M. Sonneborn, and B. Bohn.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 537-542. 1978. 1 tab, 14 ref.

Descriptors: \*Chlorination, \*Water chemistry, Water pollution, Potable water, Water quality, Germany, Water quality standards.

An overview is presented of water quality and the ordinances regulating water quality in Germany. Laws stipulate that the consumption of drinking water must not result in any impairment to the consumer's health. Studies performed in 27 different cities revealed that only chloroform was present above 1 microg/l, while the concentrations of the remaining haloforms fell within the nanogram/l range. The highest chloroform concentration observed was up to 52 microg/l. It was suggested that the main reason for the lower haloform concentrations in drinking water in Germany compared to the higher values determined in the U.S. is the dosage of chlorine for disinfecting purposes. (See also W79-05435) (Chilton-ORNL)

W79-05475

#### OZONE, CHLORINE DIOXIDE AND CHLORAMINES AS ALTERNATIVES TO CHLORINE FOR DISINFECTION OF DRINKING WATER.

Municipal Environmental Research Lab., Cincinnati, OH. Water Supply Research Div.

J. M. Symons.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 555-560. 1978. 1 tab.

Descriptors: \*Chlorination, \*Water treatment, Organic compounds, Public health, Disinfection.

A brief discussion and summary of a report containing papers by several authors is presented here. The advantages and disadvantages of chlorine as well as of each of the suggested alternatives are considered. Four alternatives presented are chlorine dioxide, ozone plus chlorine dioxide or chloramines to maintain a residual, chlorine followed shortly by ammonia to stop trihalomethane formation reaction, and chlorine dosed at a concentration less than the chlorine demand followed by chlorine dioxide or chloramines to maintain a residual. Each of these options would reduce trihalomethane concentrations, would provide adequate

initial disinfection and would provide a biocide in the distribution system. Limiting the dose of any disinfectant is also suggested. (See also W79-05435) (Chilton-ORNL)

W79-05477

#### EVALUATION OF THE CAPABILITY OF GRANULAR ACTIVATED CARBON AND RESINS TO REMOVE CHLORINATED AND OTHER TRACE ORGANICS FROM TREATED DRINKING WATER.

Drexel Univ., Philadelphia, PA. Dept. of Chemistry; and Drexel Univ., Philadelphia, PA. Environmental Studies Inst.

I. H. Suffet, J. V. Radziul, P. R. Cairo, and J. T. Coyle.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 561-582. 1978. 6 fig, 3 tab, 12 ref.

Descriptors: \*Water chemistry, \*Analytical techniques, Chlorination, Water treatment, Disinfection.

This paper presents the analysis of trace organics in drinking water, and their removal by granular activated carbon (GAC) and resins. It was concluded that GC profiles on packed columns can be utilized to successively screen primary profile changes. A peak on a packed column typically may contain three or more components and therefore analysis of subtle changes requires capillary GC. Pilot column studies showed that Filtrasorb-400 is a better adsorbent than XE-340 and that XE-340 is better than XAD-2. Performance evaluation of adsorbents was demonstrated by weekly GC profile monitoring of the organics in the influent and effluent stream of pilot columns. These profiles enabled the choice of selected samples for GC/MS identification when used in conjunction with pilot column studies. (See also W79-05435) (Chilton-ORNL)

W79-05478

#### TRIHALOMETHANE FORMATION FROM IODINE AND CHLORINE DISINFECTION OF OHIO RIVER WATER.

Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.

J. Rickabaugh, and R. N. Kinman.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee, p 583-591. 1978. 5 tab, 12 ref.

Descriptors: \*Water treatment, \*Chlorination, Disinfection, Public health, Potable water, Water quality.

Elemental iodine and a mixture of monochloramine plus iodide ion were compared to chlorine, monochloramine and to a mixture of both chlorine and iodide ion by monitoring trihalomethane formation over a pH range of 7.5 to 9.0. Data showed that elemental iodine produced 67.8 to 99.5% lower concentration of total trihalomethanes (TTHM) than did chlorine. Monochloramine-iodide ion treatment at pH values 7.5 to 8.5 produced 92.2 to 98.9% lower levels TTHM than did chlorine. At pH 9, monochloramine-iodide ion treatment produced only 80 to 87% lower TTHM levels than chlorine. In general, monochloramine-iodide ion produced the lowest levels of trihalomethanes found during this study. (See also W79-05435) (Chilton-ORNL)

W79-05479

#### THE EFFECT OF PREOZONATION ON CHLOROFORM PRODUCTION IN THE CHLORINE DISINFECTION PROCESS.

Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.

T. L. Riley, K. H. Mancy, and E. A. Boettner.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H.

## Effects Of Pollution—Group 5C

and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 593-603, 1978. 2 fig, 2 tab, 14 ref.

Descriptors: \*Water treatment, \*Chlorination, Ozone, Disinfection, Organic compounds, Public health, Environmental effects.

A study is described which compares chloroform production between model systems using ozonation-postchlorination treatment and a model system using chlorination only. The effect of preozonation on chloroform production was found to be extremely pH-dependent. If both ozonation and chlorination processes are performed in water systems below pH 8, preozonation is effective in reducing chloroform production. In water systems between pH 8 and 10, even high doses of ozone are relatively ineffective in reducing chloroform production. Either ozonation at low pH followed by chlorination at pH values above 10 or ozonation and chlorination at high pH may result in enhanced chloroform production. (See also W79-05435) (Chilton-ORNL) W79-05480

#### TRIALOMETHANE REDUCTION AT THE LOUISVILLE WATER COMPANY, Louisville Water Co., KY.

S. A. Hubbs, J. S. Zogorski, D. A. Wilding, A. N. Arbutckle, and G. D. Allgeier. In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 605-611, 1978 2 fig, 7 ref.

Descriptors: \*Chlorination, \*Water treatment, Organic compounds, Environmental effects, Public health, Ammonia.

This paper reports a program designed to establish analytical procedures, determine the occurrence and variation of trihalomethanes (THMs) in Louisville Water Company process waters, investigate the parameters controlling THM formation and devise treatment schemes that would provide a product water in compliance with anticipated EPA standards. Results showed a strongly seasonal variation in THM formation but not in raw water THM potential. A 40 to 50% reduction in THMs leaving the plant resulted from movement of prechlorination from the raw water reservoir to the coagulation process. Ammoniation at the softening basins accomplished approximately 50% reduction in THMs compared to a nonammoniated system. Ammoniation at the clearwell resulted in a 12% reduction in THMs reaching the tap. Prior to chlorination changes, total THM levels were 0.65 microM/L. Movement of chlorination to the coagulation process results in a THM level of 0.45 microM/L. If ammoniation is used optimally the level is reduced to 0.25 microM/L. (See also W79-05435) (Chilton-ORNL) W79-05481

#### GENERATION OF VOLATILE ORGANIC COMPOUNDS FROM NONVOLATILE PRECURSORS IN WATER BY TREATMENT WITH CHLORINE OR OZONE,

Colorado Univ., Boulder. Dept. of Chemistry. R. E. Sievers, R. M. Barkley, G. A. Eiceman, L. P. Haack, and R. H. Shapiro. In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31 - November 4, 1977, Gatlinburg, Tennessee. p 615-624, 1978 2 fig, 12 ref. EPA R804472010 & R803968020.

Descriptors: \*Chlorination, \*Ozone, Waste treatment, Water treatment, Organic compounds, Environmental effects, Public health.

The presence of toluene, styrene and xylenes formed by chlorine treatment is the drinking water of approximately 20 US cities is reported. The major products of ozonolysis of wastewater are identified as being aliphatic aldehydes and alkanes.

In some samples, the concentration of toluene also was found to increase upon ozonolysis. The production of aliphatic compounds in ozonized wastewater and the enhanced level of toluene found in some samples indicate that appropriate conditions of ozone treatment and/or plant influent composition may result in production of aromatic species as well as aliphatic hydrocarbons. It is suggested that investigations should be directed to determination of possible precursors of these products. (See also W79-05435) (Chilton-ORNL) W79-05482

#### A STUDY OF ALTERNATIVES TO CHLORINATION FOR DISINFECTION OF WASTEWATER,

Municipal Environmental Research Lab., Cincinnati, OH.

A. D. Venosa, and R. W. Ward.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 625-628, 1978 1 ref.

Descriptors: \*Chlorination, \*Environmental effects, Toxicity, Ozone, Bromine, Disinfection, Water treatment.

This paper is a synopsis of a more complete report recently published by the EPA. The study was conducted to determine the comparative effectiveness of chlorine, bromine chloride and ozone as disinfectants and to determine any residual toxicity associated with the use of these agents as disinfectants or with chlorinated wastewater which had been dechlorinated with sulfur dioxide. In disinfection tests, malfunctions in BrCl and O<sub>3</sub> dosing systems occurred with greater frequency than in chlorination and dechlorination systems. Chlorination produced a lethal residual toxicity effect on fathead which was eliminated by dechlorination with sulfur dioxide. Acute toxicity tests indicated that nondisinfected effluent was toxic to most species of fish tested. Ozonation coupled with filtration eliminated toxicity associated with the effluent. Salmonid fishes were more sensitive to chlorobrominated effluent than to any other effluent. Chlorinated effluent was the most toxic effluent tested. Dechlorination with sulfur dioxide reduced this toxicity to levels similar to nondisinfected effluent. (See also W79-05435) (Chilton-ORNL) W79-05483

#### BROMINE CHLORIDE AS AN ALTERNATIVE WASTEWATER DISINFECTANT TO CHLORINE,

Virginia State Water Control Board, Virginia Beach. Tidewater Regional Office.

W. L. Woodfin, Jr., R. B. Taylor, and R. C. Hoehn.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 629-636, 1978. 3 tab, 9 ref.

Descriptors: \*Chlorination, \*Environmental effects, Bromine, Chlorides, Bacteria, Disinfection, Public health.

This study compares chlorine and bromine chloride as disinfectant in filter-sterilized sewage inoculated with *Escherichia coli* and *Streptococcus faecalis* and examines the disinfection potential of both compounds in secondary effluent which has received no additional treatment. Bromine chloride was found to be the superior disinfectant against both organisms in filter-sterilized sewage containing no suspended solids. At residual concentrations as low as 0.15 mg/l in the batch reactor, BrCl provided 100% kills of *E. coli* and *S. faecalis*. Bromine chloride and chlorine were found to be equally effective in disinfecting unfiltered secondary treated effluent. (See also W79-05435) (Chilton-ORNL) W79-05484

#### A COMPARISON OF BROMINE CHLORIDE AND CHLORINE AS WASTEWATER DISINFECTANTS IN PILOT PLANT STUDIES,

Hampton Roads Sanitation District, Virginia Beach, VA.

N. E. LeBlanc, and J. M. McEuen.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 637-650, 1978. 6 fig, 4 tab, 17 ref.

Descriptors: \*Chlorination, \*Environmental effects, Water pollution, Water treatment, Bromine, Chlorides, Halogens, Pilot plants.

This paper describes pilot plant studies designed to evaluate the use of bromine chloride as a disinfectant at a 0.244 mgd disinfection pilot unit. Data gathered during the study indicate that bromine chloride and chlorine can both adequately disinfect wastewater in relation to current guidelines. The use of bromine chloride results in a significant decrease in the discharge of halogen residual. Further investigation into the technology for applying bromine chloride in large-scale applications is indicated. (See also W79-05435) (Chilton-ORNL) W79-05485

#### CHLORINE DIOXIDE DESTRUCTION OF VIRUSES AND BACTERIA IN WATER,

Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.

S. Cronier, P. V. Scarpino, and M. L. Zink.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 651-658, 1978 p. 6 gih, 7 ref. EPA R-804418.

Descriptors: \*Chlorination, \*Water treatment, Water pollution, Disinfection, Potable water, Bacteria, Water quality, Viruses.

Studies on the inactivation and destruction of viruses and bacteria by chlorine dioxide in comparison to chlorine are reported. Poliovirus 1 and coxsackievirus A9 were compared with the bacterium *Escherichia coli*. Results indicated that chlorine dioxide is an excellent disinfectant even when compared to chlorine. The test viruses were more resistant to disinfectants than *E. coli*. (See also W79-05435) (Chilton-ORNL) W79-05486

#### CHLORINE AND ACTIVATED CARBON TREATMENT FOR REMOVAL OF TOXIC SUBSTANCES FROM WATER,

Jet Propulsion Lab., Pasadena, CA.

R. G. Howland, and C. J. Wallace.

In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 659-674, 1978. 8 fig, 3 tab, 12 ref.

Descriptors: \*Chlorination, \*Water treatment, Water pollution, Toxicity, Activated carbon, Water quality.

Various treatments in which chlorination precedes treatment with activated carbon were evaluated. Results showed that the inherent dangers of chlorination are greatly reduced when a carbon-chlorine-carbon treatment is employed. Chlorination was found to enhance the removal of some compounds (phenol and aliphatic amines) over that accomplished by carbon alone. Evidence also indicated enhanced adsorptivity by activated carbon in the presence of various concentrations of chlorine. Analysis of hexane-extracted samples showed a positive advantage to the proposed treatment. Analysis of volatile low-molecular-weight halogenated hydrocarbons showed that the hazardous effect of chlorination is significantly decreased by the final carbon treatment. The final carbon treat-



### Group 5C—Effects Of Pollution

Development of facilities to  
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able levels

## Waste Treatment Processes—Group 5D

their values being less than one half of those commonly found in domestic sewage.  
W79-05009

**LAND APPLICATION OF WASTE—IMPOR-TANT ALTERNATIVE,**  
Sheaffer and Roland, Inc., Chicago, IL.  
For primary bibliographic entry see Field 5E.  
W79-05032

**LAND APPLICATION OF WASTE—STATE OF THE ART,**  
Wright-McLaughlin Engineers, Denver, CO.  
For primary bibliographic entry see Field 5E.  
W79-05033

**NITRIFICATION WITH ROTATING BIOLOGI-CAL CONTACTOR SYSTEMS,**  
Georgia Inst. of Tech., Atlanta. Environmental Resources Center.  
F. M. Saunders, and R. L. Pope.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 290. Price codes: A05 in paper copy, A01 in microfiche. Technical Completion Report No. ERC 06-78, October 1978. 85 p, 26 fig, 11 tab. OWRT A-058-GA(4). 14-31-0001-5010.

Descriptors: \*Nitrification, \*Waste water treatment, \*Nitrifying bacteria, Nitrosomonas, Nitro-bacter.

A laboratory bench-scale rotating biological con-tactor (RBC) system was utilized to evaluate the effect of microbial growth rates, expressed as cell residence time (theta sub c), on biological nitrifica-tion of a simulated secondary wastewater effluent. The effect of influent organic-nitrogen was exam-ined as well as the effect of influent wastewater organic strength at a value of theta sub c near that for washout of nitrifying microorganisms. Theta sub c values were controlled by continuous circula-tion of RBC mixed liquor to remove sloughed biomass from suspension and by periodic scraping of attached biomass from disc surfaces. Kinetic relationships developed for the nitrifying microor-ganisms in the RBC system were in agreement with those developed for pure cultures of Nitroso-monas and Nitrobacter as well as nitrification data for mixed cultures in suspended growth biological wastewater treatment systems. The critical theta sub c value for washout of nitrifying microorgan-isms was approximately 1.5d. The hydrolysis of organically-bound nitrogen was not a rate-limiting step in nitrification. Organic loadings as high as 13.7 gCOD/m<sup>2</sup>.d had no effect on nitrification at 1.4 gN/m<sup>2</sup>.d and hydraulic loading rates of 1.4 gN/m<sup>2</sup>.d and 70 l/m<sup>2</sup>.d, respectively. The results indi-cate that RBC systems can be effectively utilized for nitrification of domestic wastewaters with and without prior biological treatment. Further re-search should be conducted on pilot- and full-scale systems to determine the appropriate scale-up pa-rameters.  
W79-05047

**MICROBIAL DEGRADATION OF DYE WASTES IN AQUEOUS EFFLUENTS,**  
Georgia Inst. of Tech., Atlanta. Environmental Resources Center.  
G. B. Michaels, and E. H. White.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 219. Price codes: A03 in paper copy, A01 in microfiche. Technical completion Report No. ERC 08-78, De-cember 1978. 23 p, 4 tab. OWRT A-075-GA(1). 14-34-0001-8011.

Descriptors: \*Dyes, \*Microbial degradation, Bio-logical treatment, Textiles, \*Textile mill effluents, Sulfur dyes, Naphthol dyes.

Development of improved wastewater treatment facilities to reduce color and COD in dye-contain-ing effluents is a problem of serious concern for both the textile and carpet industries. Existing bio-logical treatment facilities reduce BOD to accept-able levels but are generally unsuccessful in reduc-

ing COD and color. Although previous studies have indicated that microbial populations would not significantly reduce the color of commercial dyes in dyehouse effluents, these studies sampled only the treatment facilities of the mills as a source of organisms which might have decolorizing po-tential. A wide variety of environmental sources were sampled for populations which could grow in dyebath solutions and decolor the dyestuffs. Carpet mill samples consisting of disperse dyes, acid dyes and disperse-acid mixtures were recalcitrant to microbial degradation. Textile dyes, how-ever, could be decolorized by microbial populations. Of the textile dye samples analyzed, 70% showed significant reduction. These suggest that microbial populations might be successfully incorporated into the design of treatment facilities for dye-con-taining effluents.  
W79-05048

**LAND APPLICATION OF WASTE—AN ACCI-DENT WAITING TO HAPPEN,**  
Pirnie (Malcolm) Inc., Silver Spring, MD.  
For primary bibliographic entry see Field 5B.  
W79-05126

**THE FEDERAL GROUND-WATER PROTEC-TION PROGRAM—TOMORROW'S UNDOING,**  
Wehran Engineering Corp., Middletown, NY.  
For primary bibliographic entry see Field 5G.  
W79-05129

**ALGAE AND WATER POLLUTION,**  
For primary bibliographic entry see Field 5C.  
W79-05322

**PROCESS FOR PHOSPHATE CONVERSION COATING WITH TREATMENT OF RINSE WATER BY REVERSE OSMOSIS AND ION EXCHANGE,**  
Nippon Paint Co. Ltd., Osaka (Japan). (Assignee). R. Murakami, and M. Zinnotti.  
U.S. Patent No. 4,130,446, 7 p, 2 fig, 4 tab, 4 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 3, p 856, December 19, 1978.

Descriptors: \*Patents, \*Waste water treatment, \*Industrial wastes, \*Industrial water, \*Water reuse, Reverse osmosis, Ion exchange, Recycling.

A process for phosphating a substrate of iron or steel comprises treating the substrate with a phos-phating solution containing phosphate ions, zinc ions and, as an accelerator, at least one member selected from the group consisting of nitrite ions, chlorate ions and bromate ions, and rinsing the thus treated substrate with water in multiple steps. A part of the rinsing water containing the phos-phating solution rinsed from the surface of the substrate is passed through a reverse osmosis mem-brane to form a concentrate and a filtrate. The concentrate is recycled for use in the phosphating solution, and filtrate is treated with ion-exchange resins of the H-type and the OH-type to remove undesirable ions and the thus treated filtrate is then recycled for use in the rinsing water. (Sinha-OEIS)  
W79-05372

**LIQUID TREATMENT PROCESS,**  
M. E. Garrett, and R. M. Keene.  
U.S. Patent No. 4,129,502, 5 p, 1 fig, 5 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 2, p. 538, December 12, 1978.

Descriptors: \*Patents, \*Waste water treatment, \*Sewage treatment, \*Water pollution treatment, Gases, Bubbles, Dissolved oxygen, Hydrogen ion concentration, Neutralization, Equipment.

A process for treating liquid by dissolving an oxygen rich gas in the water, for example waste water having a biochemical demand, comprises passing the liquid into a container, passing a stream of the liquid under pressure through a conduit, introducing gas into the stream to form bubbles of gas in the liquid, and passing the stream of liquid and gas bubbles downwardly through an expansion

chamber in which the velocity of the liquid stream is reduced to a value which allows a prolonged contact time between the gas and liquid while allowing the larger bubbles of gas to rise in the chamber. The stream is introduced into the chamber so as to create sufficient turbulence within the chamber to shatter some of the larger bubbles in the stream into relatively smaller bubbles. The stream containing liquid, dissolved gas and possi-bly relatively small bubbles of undissolved gas is passed into a lower settling zone of the container, and the pH of the liquid is controlled to a value in a predetermined range, e.g. by stripping unwanted gases, such as carbon dioxide, and/or by the addition of buffering or neutralizing chemicals. The invention also provides apparatus for treating the liquid. (Sinha-OEIS)  
W79-05377

**METHOD AND APPARATUS FOR SEPARAT-ING SOLIDS FROM LIQUIDS,**  
Ecodyne Corp., Lincolnshire, IL. (Assignee). J. A. Bell, R. B. Higgins, D. G. Mason, and J. C. Weaver.  
U.S. Patent No. 4,127,488, 5 p, 4 fig, 8 ref; Official Gazette of the United States Patent Office, Vol. 976, No. 4, p 1255, November 28, 1978.

Descriptors: \*Patents, \*Waste water treatment, \*Sewage treatment, Water pollution treatment, Separation techniques, Water clarification, Flow rates, Flow control, Gravity separation.

A method and apparatus is provided for clarifying sewage fed in through centrally discharging pe-ripheral downcomers that are readily adjustable to accommodate changing flow rates and process con-ditions. The clarification device for solids-liquid separation by gravitational settling has a peripheral inlet trough connected to uniformly spaced inlet conduits which direct influent liquid and solids toward the center of the clarifier. The size of the hole in the inlet trough can be selectively con-trolled and individually changed. This enables the volume of liquid and solids withdrawn through each hole to be controlled so as to cause the velocity energy decrease at each hole to generally equal the friction energy loss between any hole and the preceding hole while maintaining about the same volume of discharge flow. (Sinha-OEIS)  
W79-05381

**METHOD OF CLARIFYING AND REMOVING WATER FROM WATER-SOLIDS SUSPEN-SIONS,**  
Haliburton Co., Duncan, OK. (Assignee). J. L. Watson, and P. L. Totten.  
U.S. Patent No. 4,127,482, 5 p, 2 tab, 7 ref; Official Gazette of the United States Patent Office, Vol. 976, No. 4, p. 1253, November 28, 1978.

Descriptors: \*Patents, \*Waste water treatment, \*Water pollution treatment, \*Water purification, \*Suspended solids, Separation techniques, Floccu-lation, Screens, Drilling fluids.

The method for clarifying and removing water from a sump or pit containing a water-solids sus-pension such as spent aqueous drilling fluids com-prises of dispersing at least one or more of a particular class of a solids flocculating additive into the suspension in an amount sufficient to form flocculent masses of a particular size. Then the water is withdrawn from the sump through a screen of a size which prevents the flocculent masses from pass through and clarified water is continuously removed. A particularly suitable non-ionic polyacrylamide flocculating agent for floccu-lating suspended solids commonly found in drilling fluids is comprised of a mixture of polyacrylamide, a small amount of an ester of a fatty acid and a small amount of a surface active agent which in-creases the solubility of the polyacrylamide. (Sinha-OEIS)  
W79-05383

**TREATMENT OF EFFLUENTS,**  
Matthey Rustenburg Refiners (Pty) Ltd., Johan-nesburg (South Africa). (Assignee).



### Group 5D—Waste Treatment Processes

U.S. Patent No. 4,127,458, 3 p, 6 ref; Official Gazette of the United States Patent Office, Vol. 976, No. 4, p. 1246, November 28, 1978.

**Descriptors:** \*Patents, \*Industrial wastes, \*Waste water treatment, \*Metals, \*Separation techniques, Electrolysis, Electrochemistry, Hydrogen ion concentration, Temperature, Chemical precipitation, Metal recovery, Anodic oxidation, Metal refining, Platinum.

A process for recovering platinum group metal present as a stable complex dissolved in an aqueous effluent from a platinum group metals refinery comprises: (1) adjusting the pH of the effluent as necessary to an alkaline pH of at least 10; (2) heating the effluent to a temperature above 60°C; (3) electrolyzing the effluent using an electrode comprising at least one metal selected from the group consisting of Ru, Rh, Pd, Ir, Pt and alloys at an anode potential having a half-cell voltage of at least 7.5 volts and a current density of at least 0.2A/sq cm so as to break down the complex by anodic oxidation and precipitate metal present in the complex; and (4) filtering off the precipitated metal. (Sinha-OEIS)  
W79-05385

**L. O. Barkman.**  
U.S. Patent No. 4,127,440, 5 p, 1 fig, 8 ref; Official Gazette of the United States Patent Office, Vol. 976, No. 4, p 1240, November 28, 1978.

**Descriptors:** \*Patents, \*Waste water treatment, \*Pulp wastes, \*Water purification, \*Water quality control, Water pollution treatment, Pulp and paper industry, Fibers(Plant), Separation techniques.

The waste water obtained from a papermaking process is purified to remove the last traces of fibers suspended in the water by mixing the waste water with those contaminating materials that are separated from the paper pulp suspension before it is fed to the papermaking machine. These contaminants act as a filter aid and make it possible to separate the fibers remaining in the water phase after the water from the papermaking machine has been subjected to a flocculating process, filtering and screening. The great advantage of the process is that valuable fibers are recovered without there being any need to add costly filter aid which would lead to an increase in the volume of the final waste material. (Sinha-OEIS)

W79-05386

E. B. Cannell.  
Canadian Pulp and Paper Association Technical  
Section, Environment Improvement Conference,  
October 17-19, 1978, Thunder Bay, Ontario, Pre-  
prints, p L1-L2. Canadian Pulp and Paper Association,  
Montreal.

**Descriptors:** \*Pulp wastes, \*Waste water treatment, Pollution abatement, Treatment facilities, Wastes, Industrial wastes, Waste treatment, Water pollution treatment, Water pollution sources, Canada, Foreign countries, Pulp and paper industry, Effluents, Suspended solids, Screens, Sludge treatment, Sludge, Dewatering, Bark, Clarifiers, Wood rooms/Paper mill).

The primary effluent treatment system at Consolidated-Bathurst Ltd.'s kraft pulp mill consists of a traveling screen for removal of particles larger than 2.2 cm in diameter, a clarifier (47 m in diameter) for suspended solids removal, and six water extractors for sludge dewatering. Approximately 25 metric tons of suspended solids enters the system every day. Clarifier overloads and downtime necessitate by-passing of the clarifier for 20% of the time. When the clarifier and extractors are

operating, a 65% suspended solids reduction is achieved. The problem of suspended solids overload at the clarifier has been partially solved by conversion to dry barking, the removal of bark from woodroom effluent, and the installation of a knotter and a second lime mud washer. (Swichtenberg-IPC)  
W79-05416

**Ontario-Minnesota Pulp and Paper Co. Ltd., Fort  
Frances, (Ontario).**

W. R. Bennett.  
Canadian Pulp and Paper Association Technical  
Section, Environment Improvement Conference,  
October 17-19, 1978, Thunder Bay, Ontario, Pre-  
prints, p M1-M2. 1 fig. Canadian Pulp and Paper  
Association, Montreal.

**Descriptors:** \*Pulp wastes, \*Waste water treatment, \*Aerated lagoons, Wastes, Industrial wastes, Waste treatment, Water pollution treatment, Water pollution sources, Biochemical oxygen demand, Canada, Foreign countries, Pulp and paper industry, Effluents, Lagoons, Aeration, Hydrogen ion concentration, Foaming, Winter, Operating problems. Aerators. Kraft mills.

The aeration lagoon at the Ontario-Minnesota Pulp and Paper Co. Ltd., Fort Frances, Ontario, began operation in conjunction with the startup of a bleached kraft pulp mill in November 1971. The lagoon is J-shaped, approximately 3100 ft long, 430 ft wide, and 12 ft deep and has a design retention time of 5 days. Aeration is provided by nine 75 hp low-speed floating aerators. The present BOD loading is approximately 60,000 lb/day, of which 22,000 lb/day originate in paper mill wastes. The efficiency of the system is low since the aerators can reduce only about 32,000 lb of BOD/day. This situation will be alleviated with the startup of a new clarifier and paper mill in-plant fiber recovery system. Problems experienced at the lagoon included pH and other shocks, windblown foam, capsizing of the floating aerators during the winter, and excessive BOD loading after it was decided to treat specialty-paper mill effluents in addition to kraft mill effluents. (Swichtenberg-IPC)

W79-05417

**Domtar Fine Papers, Cornwall (Ontario).**

**I. W. A. Snider.**  
Canadian Pulp and Paper Association Technical  
Section, Environment Improvement Conference,  
October 17-19, 1978, Thunder Bay, Ontario, Pre-  
prints, p K1-K5. 5 fig. Canadian Pulp and Paper  
Association, Montreal.

**Descriptors:** \*Pulp wastes, \*Waste water treatment, \*Treatment facilities, Canada, Pulp and paper industry, Effluents, Wastes, Industrial wastes, Water pollution treatment, Waste treatment, Water pollution sources, Foreign countries, Sludge, Sludge treatment, Dewatering, Suspended solids, Water pollution control, Filters, Clarifiers, Fiber recovery, Black liquor, Spills.

The primary effluent treatment facility at Donnan Fine Papers Ltd. (Canada) consists of a 386 ft (118 m) long diffuser with a grit chamber, a 250 ft (76 m) diameter clarifier, sludge removal and dewatering equipment, and a screen/centrifuge system for removal of fiber from the sludge. The system can handle an effluent flow of 60,000,000 imperial gal/day (273,000 cu m/day). Poor suspended solids removal by the clarifier was alleviated by in-plant measures, namely, a black liquor spill collection system, startup of a belt filter for removal of the green liquor dregs, and conversion to dry barking. (Swichtenberg-IPC)  
W79-05418

Prince George Pulp and Paper Ltd. (British Co-

**J. McDonald.**

Canadian Pulp and Paper Association Technical Section, Environment Improvement Conference, October 17-19, 1978. Thunder Bay, Ontario, Preprints, p II-19. 7 fig, 4 tab. Canadian Pulp and Paper Association, Montreal.

**Descriptors:** \*Pulp wastes, \*Waste water treatment, \*Treatment facilities, Water pollution treatment, Water pollution sources, Wastes, Industrial wastes, Waste treatment, Pulp and paper industry, Effluents, Canada, Foreign countries, Biochemical oxygen demand, Aeration, Aerated lagoons, Activated sludge, Lagoons, Bleaching wastes, Toxicity, Clarifiers, Kraft mills.

Primary clarifiers were installed to handle the fiber-containing kraft mill effluents at the treatment facilities of Prince George Pulp and Paper Ltd. and Intercontinental Pulp Co. Ltd. of Canada. To improve BOD removal, an aeration stabilization basin (ASB) with a 245,000,000 gal capacity and a 4.3-day retention time was constructed at Prince George to receive the effluent from the primary clarifiers and low-rate activated sludge lagoons (which process bleach plant effluents and toxic spills) of both kraft mills. Design parameters and problems with the basin are discussed, including reasons for using subsurface aeration. An effluent flowsheet and performance data for the ASB are also included. (Switchenberg-IPC)

W79-05419

Environmental Protection Service,  
Edmonton (Alberta).

J. B. Bell, W. Macrae, J. F. J. Zaal, and J. M. Vanderpost.  
Canadian Pulp and Paper Association Technical Section, Environment Improvement Conference, October 17-19, 1978, Thunder Bay, Ontario, Preprints, p. H1-H13. 7 fig, 26 ref, 5 tab. Canadian Pulp and Paper Association, Montreal.

**Descriptors:** \*Pulp wastes, \*Municipal wastes, \*Waste water treatment, \*Bacteria, Water pollution sources, Wastes, Industrial wastes, Salmonella, Enteric bacteria, Microorganisms, Sewage bacteria, Coliforms, Aquatic microorganisms, Aquatic bacteria, Pulp and paper industry, Aeration, Waste treatment, Water pollution treatment, Klebsiella, Effluents.

Laboratory fermenter and field studies conducted by Environment Canada indicate that *Salmonella* paratyphi B cannot compete with normal flora during aeration of combined kraft pulp mill/municipal effluent at temperatures above 20C. Survival for more than 14 days occurred at temperatures of 4-10C. *Salmonella* paratyphi B survived for prolonged periods in domestic sewage at 30C even with aeration. The correlation coefficient for *Salmonella* and coliforms survival under similar situations was 0.7989, indicating that coliform growth patterns in this type of effluent mixture may be used to predict *Salmonella* growth patterns. Coliforms and fecal coliforms were reduced by 99.87 and 99.66%, respectively, in the combined effluent treatment system. More than 50% of the coliforms and fecal coliforms discharged by the combined treatment system were *Klebsiella*. (Swichtenberg-IPC)

W79-05420

**EFFECT OF PROCESS WATER RECYCLE ON POLLUTION CONTROL AND ENERGY CONSERVATION,**  
Consolidated-Bathurst Ltd., Montreal (Quebec).  
For primary bibliographic entry see Field 3E.  
W79-05422

## DEVELOPMENT OF A PRACTICAL METHOD TO REDUCE THE TOXICITY OF KRAFT MILL EFFLUENTS BY RETAINING SOME OF THE TOXIC MATERIALS WITH THE PULP.

## Ultimate Disposal Of Wastes—Group 5E

Boomtech Services Ltd., Ottawa (Ontario).

Canadian Environmental Protection Service, Ottawa, Ontario K1A 1C8. Cooperative Pollution Abatement Research (CPAR) Project Report 617-1, Final Report to March 31, 1977, 58 p. 1 fig, 9 ref, 16 tab. CPAR 617-1

Descriptors: \*Pulp wastes, \*Toxicity, \*Bleaching wastes, \*Water pollution control, Wastes, Industrial wastes, Water pollution sources, Hydrogen ion concentration, Adsorption, Chlorination, Pulp and paper industry, Effluents, Surfactants, Black liquor, Resin acids, Kraft pulp, Talc, Pollution statement.

The adsorption of resin acids and other toxicants on kraft pulp from black liquor and spent bleaching liquors was studied using laboratory and mill pulps and liquors. The major factor in adsorption was found to be the solution pH; the adsorption increased as the pH was decreased from 11 to 2. The addition of talc increased the adsorption of resin acids from alkaline solutions; surfactants decreased the adsorption. The toxicity of dilute black liquor or bleaching effluents (caustic extraction stage effluents) was decreased by the adsorption of resin acids and other toxicants on pulp. Chlorination decreased the toxicity of resin acids, and alkaline treatment of the chlorination-stage effluent decreased the toxicity substantially. Methods to decrease mill effluent toxicity by adsorption or desorption of toxicants are discussed. (Witt-IPC) W79-05424

#### USE OF THE ACTIVATED SLUDGE PROCESS IN THE TREATMENT OF THERMOMECHANICAL PULPING EFFLUENTS.

Australian Newsprint Mills Ltd.  
D. S. Thurley, and D. E. Richardson.  
Appita, Vol. 32, No. 2, p 103-108, September, 1978, 6 fig, 14 ref, 3 tab.

Descriptors: \*Pulp wastes, \*Waste water treatment, \*Activated sludge, Detoxification, Wastes, Industrial wastes, Waste treatment, Water pollution sources, Pulp and paper industry, Effluents, Biological treatment, Foreign countries, Pine trees, Pinus radiata, Biochemical oxygen demand, Suspended solids, Color, Bioassay, Aquatic microorganisms, Toxicity, Pilot plants, Australia, Thermo-mechanical pulping, Newsprint mills.

Pilot-scale investigations were carried out to determine the suitability of activated sludge treatment of thermomechanical pulping effluents. Pulp is produced from Pinus radiata chips in a Bauer double-disk refiner, diluted to approximately 5% stock consistency to simulate water usage in a newsprint mill, filtered, and the filtrate is used as feed to the secondary effluent treatment pilot plant. The average 5-day BOD of the feed is 770 mg/liter while the effluent from the plant has an average 5-day BOD of 10 mg/liter, suspended solids of 17 mg/liter, and a color of less than 120 Hazen units. Bioassays, using a variety of aquatic organisms, have shown that the activated sludge successfully removes the toxic components from the pulping wastes. (Swichtenberg-IPC) W79-05425

#### CONTROL OF ACTIVATED SLUDGE BULKING DURING BIOLOGICAL PURIFICATION (REGULIROVANIE PRIRODA AKTIVNOGO IIA PRI BIOLOGICHESKOI OCHISTKE), GIPROBUM (USSR).

M. A. Evilevich, and L. K. Korovin.  
Dumazhnaya Promyshlennost', No. 8, p 27-28, August, 1978, 3 fig, 1 tab.

Descriptors: \*Activated sludge, \*Waste water treatment, \*Control, Organic loading, Water pollution treatment, Water quality control, Wastes, Waste treatment, Water pollution sources, Biological treatment, Sludge, Equations, Suspended solids, Aeration, Water purification, Solid wastes, Mass balance.

Biological purification of effluents is accompanied by changes (Bulking) in the mass of the activated sludge. A condition for the stability of the purification process is the maintenance of a strict balance

between the discharge of excess sludge and its increment. An analysis was made of the activated sludge process, and a mass balance equation was obtained expressing the discharge of activated sludge from the system (tons/day) as a function of the total amount of suspended solids entering the aeration tanks (tons/day), amount of organic impurities removed in the tanks (tons of 5-day BOD/day), and a parameter, named activated sludge increment coefficient, representing the product of the economic increment coefficient (ratio of biomass concentration to the concentration of the substrate) and a dimensionless function (derived from the process variables). The correctness of the relation was confirmed by experimental data. The sludge increment coefficient depends on the quality of the suspension entering the aeration tanks and the activated sludge load. The activity in the system is controlled by varying the amount of sludge discharged, to maintain the stability of the purification process. (Stapinski-IPC) W79-05431

#### SOLUBLE ORGANIC CONSTITUENTS OF NATURAL WATERS AND WASTEWATERS BEFORE AND AFTER CHLORINATION.

North Texas State Univ., Denton. Inst. of Applied Sciences; and North Texas State Univ., Denton. Dept. of Chemistry.  
For primary bibliographic entry see Field 5A. W79-05436

#### THE EFFECT OF PREOZONATION ON CHLOROFORM PRODUCTION IN THE CHLORINE DISINFECTION PROCESS.

Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.  
For primary bibliographic entry see Field 5C. W79-05480

#### TRICHALOMETHANE REDUCTION AT THE LOUISVILLE WATER COMPANY.

Louisville Water Co., KY.  
For primary bibliographic entry see Field 5C. W79-05481

#### GENERATION OF VOLATILE ORGANIC COMPOUNDS FROM NONVOLATILE PRECURSORS IN WATER BY TREATMENT WITH CHLORINE OR OZONE.

Colorado Univ., Boulder. Dept. of Chemistry.  
For primary bibliographic entry see Field 5C. W79-05482

#### ULTRAVIOLET DISINFECTION OF MUNICIPAL EFFLUENTS.

Municipal Environmental Research Lab., Cincinnati, OH.

A. D. Venosa, H. W. Wolf, and A. C. Petrasek.  
In: Water Chlorination: Environmental Impact and Health Effects, Vol. 2, Jolley, R. L., Gorchev, H. and Hamilton, D. H., Jr., (Eds.). Proceedings of a Conference, October 31-November 4, 1977, Gatlinburg, Tennessee. p 675-684, 1978, 2 tab, 1 ref.

Descriptors: \*Water treatment, \*Ultraviolet radiation, Disinfection, Water quality, Dallas, Design.

The advantages and disadvantages of irradiation with ultraviolet light as a method of disinfection of water is discussed. A case, The Dallas Study, is reported with emphasis on the relationship between dosage and disinfection. It was suggested that, since the applied dosage of UV light is directly related to the quality of water being treated and to the log reduction in microbial numbers, more intensive effort is needed to develop accurate means of measuring dosage in UV exposure chambers. Further investigation is also indicated on the occurrence and prevention of film buildup on quartz sleeves and viewing windows. Chemical vs mechanical cleaning procedures should be compared for long-term effectiveness. (See also W79-05435) (Chilton-ORN) W79-05488

BLEACH PLANT OPERATION,  
Erco Envirotech Ltd., London (England).  
For primary bibliographic entry see Field 3E. W79-05497

### 5E. Ultimate Disposal Of Wastes

#### EFFECTS OF SLUDGE APPLICATIONS ON SOIL WATER SOLUTION AND VEGETATION IN A NORTHERN HARDWOOD STAND.

New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.  
M. T. Koterba, J. W. Hornbeck, and R. S. Pierce.  
Journal of Environmental Quality, Vol. 8, No. 1, p 72-78, January-March, 1979, 6 fig, 4 tab, 30 ref. OWRT A-039-NH(4), 14-31-0001-4029.

Descriptors: Forest management, \*Sludge, Nutrients, \*Leaching, Microbial degradation, Sludge treatment, Forest soils, Recycling, Biodegradation, Cations, Anions, Growth rates, Plant growth, \*Land application, Soil water.

Dewatered and limed sludge from a primary treatment plant was applied at two rates, 25 and 125 wet metric tons/ha (5.8 and 28.0 dry metric tons/ha), on sandy loam soils in a northern hardwood forest in central New England. Changes in soil water solution were assessed from water samples collected with suction lysimeters at 20- and 45-cm depths below the mineral surface. The light application of 25 metric/ha had little effect, but the heavy application of 125 metric/ha caused an increase in the concentration of most ions in soil water. The concentrations of most ions returned to background levels within 1 year after sludge application. There were no significant differences in basal-area growth among control and treated plots for the first two growing seasons after sludge application. In the herb and shrub layer only 3 of the 31 commonly occurring species showed statistically significant changes in frequency. All three changes were on plots receiving the heavy application. W79-05002

#### LAND APPLICATION OF WASTE—IMPORTANT ALTERNATIVE.

Sheaffer and Roland, Inc., Chicago, IL.  
J. R. Sheaffer.  
Ground Water, Vol. 17, No. 1, p 62-68, January-February 1979, 1 fig, 3 tab, 8 ref.

Descriptors: \*Waste water disposal, \*Waste water treatment, \*Sewage effluent, Irrigation, Agriculture, Land management, Soils, Nutrients, Chemicals, Sewage treatment, Pollutants, Groundwater, \*Land application, Land treatment.

Land treatment uses a combination of processes to manage and beneficially use wastewater. The treatment represents a revolution in sewage treatment because it: (1) transforms sewage treatment from a single purpose activity into a multipurpose activity, (2) changes sewage treatment construction grants from subsidies into investments in the production of food and fiber, and (3) requires the participation of a variety of disciplines to implement successfully. Because it is revolutionary to the sewage treatment field, three situations have developed. First, it is displacing traditional technology at a record-breaking pace. Second, its logical appeal to thinking decision makers has created a situation in which the policy makers are ahead of many technicians. Third, it is attacked with a fervor heretofore unknown in the sewage treatment field. Land treatment has logged an enviable track record in the United States. Existing systems have produced a high quality effluent at economically competitive prices. In addition, in terms of relative risk, the threat to environmental quality from a land treatment system compares favorably with advanced waste treatment systems. (Sims-ISWS) W79-05032

LAND APPLICATION OF WASTE—STATE OF THE ART,  
Wright-McLaughlin Engineers, Denver, CO.



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5E—Ultimate Disposal Of Wastes

K. R. Wright, and C. K. Rovey.  
Ground Water, Vol. 17, No. 1, p 47-61, January-February 1979. 2 fig, 9 tab, 18 ref.

Descriptors: \*Waste water disposal, \*Waste water treatment, \*Sewage effluents, Sewage sludge, Irrigation, Agriculture, Land management, Pastures, Crops, Groundwater, Soils, Nutrients, Nitrogen, Phosphorus, Monitoring, Reviews, \*Land application, Land treatment.

Land application of treated wastewater can provide unique opportunities, not only for a final high level of wastewater treatment but also for reuse of nutrients. Recent laws passed by Congress have made it necessary to consider land treatment when planning and designing new wastewater treatment facilities. The three types of land treatment commonly used are irrigation, overland flow, and rapid infiltration. Selection of the most appropriate type of land treatment for a specific site is based on several considerations, including soil conditions, geology, topography, proximity to surface and subsurface water, and climate. Ensuring the protection of groundwater is essential when siting or designing a land treatment system. Groundwater is an important natural resource, having considerable impact on human life and well-being as well as high economic value. Safeguarding this important resource from contamination includes careful site selection, appropriate pretreatment of wastewater prior to its application, and a program of regularly scheduled monitoring to ensure that the wastewater is being properly renovated for safe release to the environment. Utilization of municipal sludge on land for agricultural production is encouraged by federal law, as is land treatment of wastewater. Sludge contains concentrated wastes, and there are practical limitations on the levels of heavy metals, salts, and toxic substances in sludges applied to agricultural lands. Sludge is generally stabilized before being applied to destroy pathogens and to reduce weight, volume, and odor. (Sims-ISWS)

W79-05033

**SURFACE RUNOFF FROM SLUDGE-AMENDED SOILS.**  
Purdue Univ. Lafayette, IN. Dept. of Agronomy.  
For primary bibliographic entry see Field 5B.  
W79-05041

**LAND APPLICATION OF WASTE—AN ACCIDENT WAITING TO HAPPEN.**  
Pirnie (Malcolm) Inc., Silver Spring, MD.  
For primary bibliographic entry see Field 5B.  
W79-05126

**APPLICATION OF PHASED COOLING TO A ONCE-THROUGH COOLING SYSTEM.**  
Auburn Univ., AL. Dept. of Mechanical Engineering.  
For primary bibliographic entry see Field 5B.  
W79-05227

**SLUDGE TO LAND—ECONOMIC CONSIDERATIONS FOR WATER AUTHORITIES.**  
Water Research Center, Medmenham (England).  
Medmenham Lab.  
For primary bibliographic entry see Field 6B.  
W79-05320

**A WATER DEMAND AND WASTEWATER DISPOSAL MODEL FOR OPTIMUM TRANSFER OF WATER RESOURCES TECHNOLOGY IN DEVELOPING COUNTRIES.**  
Federal Univ. of Parais, Campina Grande (Brazil). Dept. of Civil Engineering.  
For primary bibliographic entry see Field 6D.  
W79-05413

### 5F. Water Treatment and Quality Alteration

**LAND APPLICATION OF WASTE—IMPOTANT ALTERNATIVE.**  
Sheaffer and Roland, Inc., Chicago, IL.  
For primary bibliographic entry see Field 5E.  
W79-05032

**LAND APPLICATION OF WASTE—STATE OF THE ART.**  
Wright-McLaughlin Engineers, Denver, CO.  
For primary bibliographic entry see Field 5E.  
W79-05033

**FATE OF METAL IONS DURING DOMESTIC TREATMENT OF WATER CONTAINING ORGANICS.**  
New Hampshire Univ., Durham. Dept. of Chemistry.  
J. H. Weber, and R. E. Truitt.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 147.  
Price codes: A03 in paper copy, A01 in microfiche.  
Water Resource Research Center, University of New Hampshire, Research Report No. 21, 1979. 29 p, 8 tab, 40 ref. OWRD A-046-NH(1). 14-31-0001-3829.

Descriptors: \*Fulvic acids, \*Coagulation, \*Water treatment, \*Filtration, Separation techniques, Ions, Ion removal, Alum.

Preliminary to water treatment experiments, several filter media were tested to determine Cd<sup>2+</sup> losses during filtration at pH 8. The initial concentrations of Cd<sup>2+</sup> were 4.5 and 45 ppb. Various filtering materials sorb different amounts of Cd<sup>2+</sup> from solution as a function of their surface area and the speed of filtration. Polycarbonate filter membranes in combination with a polycarbonate support apparatus gave the lowest Cd<sup>2+</sup> losses when the filtrate is collected directly in a volumetric flask. The effectiveness of Cu<sup>2+</sup>, Cd<sup>2+</sup>, and Zn<sup>2+</sup> removal from solution by alum coagulation was measured with fulvic acid present and absent. A factorial experimental design and analysis of variance were used to determine the effect on metal ion removal of the individual variables pH, metal ion concentration, alum concentration, and fulvic acid concentration and their combinations. The variable levels model water treatment plant conditions. Maximum metal ion losses on 96% for Cu<sup>2+</sup>, 59% for Cd<sup>2+</sup>, and 82% for Zn<sup>2+</sup> were measured in the presence of fulvic acid. In its absence the maximum metal ion losses were 93% for Cu<sup>2+</sup>, 14% for Cd<sup>2+</sup>, and 53% for Zn<sup>2+</sup>. Fulvic acid enhances metal ion removal under most experimental conditions. The practical implication on the results is that strong complexes between natural water organic matter and metal ions enhance their removal by the alum coagulation process.

W79-05046

**IONIZATION CHAMBER FOR WATER TREATMENT SYSTEM.**  
Water-Tronics, Inc., Charlotte, NC. (Assignee).  
C. N. Smith.  
U.S. Patent No. 4,127,467, 7 p, 4 fig, 4 ref; Official Gazette of the United States Patent Office, Vol. 986, No. 4, p. 1248, November 28, 1978.

Descriptors: \*Patents, \*Water treatment, \*Scaling, Industrial water, Ionization, Demineralization, Electrodes, Equipment, Ionization chamber.

An ionization chamber for use in eliminating or controlling scale in water systems includes a generally cylindrical housing having a side wall and ends, and an electrode, extending within the housing along the longitudinal axis. The electrode and the housing are connected to the opposite poles of a source of direct current. The electrode projects into the housing through one end wall and the extending end of the electrode is spaced from the opposite end wall of the housing by a dimension

substantially equal to the radial spacing between the electrode and the side wall of the housing. A dielectric sleeve is arranged about the electrode, and extends along the electrode from one end wall for a length corresponding to the spacing between the end of the electrode and the opposite end wall of the housing. As a result, the exposed electrically conductive portion of the electrode is substantially equally spaced at all points from the surrounding housing, whereby the electrical energy generated between the housing and the electrode is substantially evenly distributed throughout the ionization chamber. (Sinha-OEIS)

W79-05384

**PROCESS FOR INHIBITING CORROSION OF METALS IN AQUEOUS SYSTEMS.**  
Hercules Inc., Wilmington, DE.  
D. C. Zecher.  
U.S. Patent No. 4,093,557, 8 p, 6 tab, 9 ref; Official Gazette of the United States Patent Office, Vol. 971, No. 1, p. 279, June 6, 1978.

Descriptors: \*Patents, \*Water treatment, \*Industrial water, \*Cooling water, Corrosion, Corrosion control, Scaling, Organic compounds, Chemical reactions.

A process is described for inhibiting of corrosion of metal surfaces in contact with cooling water principally in open-recirculating cooling water systems by maintaining contact of the surfaces within the system with corrosion inhibiting compounds characterized by the presence of at least one quinoimethide group within the compound. (Sinha-OEIS)

W79-05391

**CONTROLLING IRON OXIDE DEPOSITION IN BOILER SYSTEMS.**  
Nalco Chemical Co., Chicago, IL.  
For primary bibliographic entry see Field 3C.  
W79-05498

**BOILER WATER TREATMENT: IS THE PAPER INDUSTRY A SPECIAL CASE.**  
Betz Lab., Inc., Trevose, PA.  
G. Levine.  
TAPPI Engineering Conference, San Francisco, California, September 19-21 1978, Preprinted Proceedings (TAPPI, Atlanta, Georgia), p. 233-241. 6 fig, 11 illus, 8 ref.

Descriptors: \*Boiler feed water, \*Water treatment, Industrial water, Pulp and paper industry, Water softening, Demineralization, Boilers, Iron compounds, Phosphates, Corrosion, Hydrogen ion concentration, Water quality, Condensates.

This article describes the uniqueness of water treatment in the paper industry and the means to cope with the problem. The major problem plaguing the industry is the quantity of iron corrosion products generated in the utility cycle and their subsequent deposition in the boiler. A well-managed and well-monitored external and condensate treatment program is vital to keep contaminants from reaching the boiler. Where iron is of concern, an ethylenediamine tetraacetic acid/dispersant program provides the best relief. If caustic corrosion is a potential problem, the use of a coordinated pH/phosphate control program will provide the necessary protection. Highly specific dispersants have also been developed for use in boilers where hardness contaminants have been the major problem. These dispersants distort and further inhibit the growth of deposition crystals, allowing them to be removed with the blowdown. (Witt-IPC)

W79-05499

### 5G. Water Quality Control

**PLANT NUTRIENT LOSSES FROM FOLIAR FERTILIZED SOYBEANS.**  
Iowa State Univ., Ames. Dept. of Agricultural Engineering.  
J. L. Baker, and J. M. Laflen.

Paper No. Meeting of Engineers, fig. 1 tab.

Descriptors: Nutrients, \*Fertilized rain.

To determine soybeans was applied fertilizer a kg/ha N, Washoff water was PO4-P, an initially in plants was (Skogerboe)

W79-05050  
THE FED TION PRO Environm DC. Office V. J. Kimb Ground W February 1

Descriptor Water po Environm ity, Water hants, W Waste wat

The Nation vast and of mental Pro number of many case Separate r Safe Drink tion and R must be c effective. within the major prin comment (are: (1) Th will be a State and participate effective. (the preven treatment a cable stand ogy rather siderations mbient qu and of long environm and contin that the ro health whil of us-gove acts of cor to the pote we are to lecting the resources. (W79-05127

THE FED TION PRO Environm C. W. Seve Ground W February 1

Descriptor rol, \*Water Legal aspe Water polli Waste wa pollutants, water.

## Water Quality Control—Group 5G

Paper No. 78-2084, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 11 p, 5 fig, 1 tab, 4 ref. ASAE, St. Joseph, Michigan.

Descriptors: \*Fertilization, Nutrient removal, Nutrients, \*Foliar application, Runoff, Soybeans, Simulated rainfall, Corn.

To determine the impact of foliar-fertilization of soybeans on runoff water quality, simulated rainfall was applied to soybeans and corn receiving no fertilizer and to soybean plots foliar-fertilized (20 kg/ha N, 2 kg/ha P) 39 and 13 hr before rainfall. Washoff water from plants and surface runoff water were analyzed for NH<sub>4</sub>-N, NO<sub>3</sub>-N, total N, PO<sub>4</sub>-P, and hydrolyzable-P. Foliar-fertilization did initially increase concentrations of dissolved nutrients in runoff, but most N and P washed from plants was retained by the soil within plot areas. (Skogerboe-Colorado State) W79-05056

**THE FEDERAL GROUND-WATER PROTECTION PROGRAM—A REVIEW**, Environmental Protection Agency, Washington, DC. Office of Drinking Water. V. J. Kimm. Ground Water, Vol. 17, No. 1, p 75-79, January-February 1979. 3 append.

Descriptors: \*Federal government, \*Groundwater, \*Water pollution control, \*Water quality control, Environmental control, Legal aspects, Water quality, Water pollution, Water pollution sources, Pollutants, Water wells, Aquifers, Injection wells, Waste water disposal, Reviews.

The Nation's groundwater resources constitute a vast and often unprotected resource. The Environmental Protection Agency is about to launch a number of programs designed to protect what is, in many cases, a virtually nonrenewable resource. Separate regulatory activities mandated under the Safe Drinking Water Act, the Resource Conservation and Recovery Act, and the Clean Water Act must be coordinated carefully if they are to be effective. The current implementation efforts within the agency are being framed in view of our major principles which will be the focus of public comment in the months ahead. These principles are: (1) The administration of the related programs will be a cooperative effort involving Federal, State and local governments, all of which must participate in formulating the program if it is to be effective. (2) The focus of the programs will be on the prevention of contamination rather than on its treatment at the point of withdrawal. (3) The applicable standards will be based primarily on technology rather than ambient groundwater quality considerations since the effects of discharges upon ambient quality are complex, difficult to predict, and of long duration. (4) There is a need to balance environmental protection, energy development, and continued economic prosperity objectives so that the resulting programs fully protect public health while being realistically implementable. All of us—government, industry and citizens, through acts of commission or omission—have contributed to the potential problem. We must work together if we are to get on with the important task of protecting the quality of the Nation's groundwater resources. (Sims-ISWS) W79-05127

**THE FEDERAL GROUND-WATER PROTECTION PROGRAM—TODAY'S HOPE**, Environmental Protection Agency, Dallas, TX. C. W. Sever. Ground Water, Vol. 17, No. 1, p 80-82, January-February 1979.

Descriptors: \*Groundwater, \*Water pollution control, \*Water quality control, \*Federal government, Legal aspects, Water quality, Water pollution, Water pollution sources, Injection wells, Lagoons, Waste water disposal, Aquifers, Pollutants, Path of pollutants, Water supply, Water resources, Potable water.

The necessary administrative mechanisms for protection of our underground drinking water sources, and coordination of natural resource and energy development and environmental quality programs, should be provided by a federal groundwater control program, else today's underground contaminant disposal activities will be tomorrow's undoing. Federal regulations, however, must provide flexibility to States and industry to find the least costly means of meeting national environmental goals. A growing body of literature clearly documents cases of underground drinking water source contamination, sometimes severe, from a large variety of conditions and practices. Existing studies also indicate that this problem is pervasive: aquifers have been adversely affected in every region of the country. A federal groundwater protection program which (1) reflects consideration of total long-range natural resource protection and environmental quality benefits, (2) regulates in a manner so that the benefits to the environment generally exceed the regulatory costs, and (3) encourages more efficient ways of meeting environmental goals in the least costly manner can and must be developed by the Environmental Protection Agency. Without an effective Federal groundwater protection program, the underground contamination problem will likely worsen. (Sims-ISWS) W79-05128

**THE FEDERAL GROUND-WATER PROTECTION PROGRAM—TOMORROW'S UNDOING**, Wehran Engineering Corp., Middletown, NY. D. C. Mosher. Ground Water, Vol. 17, No. 1, p 83-86, January-February 1979. 5 ref.

Descriptors: \*Groundwater, \*Water pollution control, \*Landfills, Water pollution, Water pollution sources, Landfills, Solid wastes, Waste disposal, Leachate, Leaching, Pollutants, Path of pollutants, Federal government, Legal aspects, Aquifers, Water resources, Water supply, Water quality, Water quality control.

Past and present guidance in landfilling has been based on inadequate information. More recent information indicates past and present recommendations/guidance may not be accurate. Current trends, as a result of RCRA (PL 94-580), are generally following the same recommendations. The result can be greater problems from landfills constructed now and in future years than have occurred from past landfills, such as the well-known Llangollen landfill. It is time for Congress, EPA, and others to recognize what is and is not known about the pollution potential from landfills and waste disposal in general. (Sims-ISWS) W79-05129

**STATE GROUND-WATER PROTECTION PROGRAMS—A NATIONAL SUMMARY**, Environmental Protection Agency, Chicago, IL. Region V. R. E. Bartelt. Ground Water, Vol. 17, No. 1, p 89-93, January-February 1979. 6 fig, 1 ref.

Descriptors: \*Groundwater, \*Water pollution control, \*State governments, \*Legal aspects, Reviews, Surveys, Legislation, Water pollution, Water pollution sources, Pollutants, Injection wells, Waste water disposal, Chemicals, Oil, Path of pollutants, Aquifers, Water quality, Water quality control.

In order to discuss the adequacy or inadequacy of State groundwater protection programs, it is helpful to establish a base line which may be used as a frame of reference for the discussion. To provide that frame of reference, the 50 States were contacted and representatives were questioned as to the nature and extent of their existing groundwater programs. The survey of States produced a wealth of information relative to the structure of various State programs, and this information was presented graphically in the neutral presentation. The subject of multiple agency involvement was addressed. In addition to looking at the structure of State programs, information was collected regarding the

nature of existing State statutes and regulations. Tabulation and interpretation of this information were provided to illustrate how the institutions are providing for the protection of our groundwater resources. In addition to evaluating the various types of statutes, existing enforcement mechanisms were researched and presented for review. Graphic presentations of the national data base were used, and again several States' procedures were reviewed in detail. The topic of groundwater quality standards was specifically addressed during interviews in order to note the extent of this developing regulatory technique. The presentation provided a national look at existing groundwater programs with in-depth analysis of certain State programs. The variations in State programs were highlighted and an attempt was made to estimate resources currently dedicated to groundwater protection at the State level. (Sims-ISWS) W79-05130

**STATE GROUND-WATER PROTECTION PROGRAMS—INADEQUATE**, Virginia State Water Control Board, Roanoke. West Central Regional Office. J. W. Dawson. Ground Water, Vol. 17, No. 1, p 102-108, January-February 1979. 12 fig, 4 ref.

Descriptors: \*Groundwater, \*Water pollution control, \*State governments, \*Legal aspects, Reviews, Surveys, Water quality standards, Water resources, Pumping, Water wells, Drilling, Water policy, Water management (Applied), Legislation, Administration agencies, Aquifers, Water quality, Water quality control.

The primary reason state groundwater protection programs are inadequate is that the resource is misunderstood, surrounded by misconceptions and, due to its occurrence, is 'out of sight and out of mind.' To most people, groundwater is a very elusive and somewhat magical resource, whose significance in the over-all picture of water resources has not been realized by those who have the power and authority to rectify the present state of affairs. The need for adequate protective legislation and sufficient financial and manpower resources commitment is even more difficult to justify because, to date, there has not been a citizen outcry for such measures. To ascertain the status of current state groundwater protection programs, a survey of state legislation concerning groundwater was undertaken; additionally, a questionnaire was sent to the agency in each state responsible for administration of groundwater protection programs. The results of this survey indicate that most states have broad authority over groundwater resources through general water resources legislation, but the majority do not have specific groundwater protective legislation. In many cases, the broad legislative authority is inadequate or, if legislation is adequate, implementation of legislative mandates is not sufficient to provide adequate protection. Lack of groundwater quality and quantity data is severe to the point that many agencies do not have a realistic characterization or identification of the groundwater resources they are to protect. (Sims-ISWS) W79-05131

**STATE GROUND-WATER PROTECTION PROGRAMS—ADEQUATE**, Minnesota Dept. of Health, Minneapolis. E. H. Ross. Ground Water, Vol. 17, No. 1, p 94-101, January-February 1979. 11 fig, 3 tab, 15 ref.

Descriptors: \*Groundwater, \*Water pollution control, \*State governments, \*Legal aspects, \*Minnesota, Costs, Economics, Water resources, Water quality, Water quality control, Education, Aquifers, Political aspects.

An assessment of the adequacy of State involvement should include a historical perspective of resource management in the nation. A review of the record indicates that up until the 70's, Federal policy was virtually nonexistent with respect to groundwater protection programs. Efforts of the



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5G—Water Quality Control

groundwater industry and related scientific community to gain legislative action have shown progress within State government within the last few years. The Federal EPA, in response to efforts of the only significant constituency, the NWWA, is now requiring groundwater protection in their regulations. Institutional arrangements, whether national, State, or local, at least for some years to come by political necessity will require central involvement of the States in groundwater protection. The legislative and executive branches in many States have shown their willingness to act; however, without an active political constituency, legislative appropriations are provided after actual problems arise due to drought or contamination problems. Rainfall provides extra time to address quantity problems, but there may not be a second chance to protect groundwater quality. These branches of government have the monetary and legal authority to act once the need is demonstrated. The record of the judicial branch indicates a need for the legislative and executive branches to design and manage programs that will avoid the necessity of court action. Continued advocacy efforts for groundwater protection programs yet remain the responsibility of the water well industry and a small groundwater technical constituency. The public and the politicians need to be further informed and educated about the need for groundwater protection. (Sims-ISWS)

W79-05132

#### NON-POINT WATER QUALITY MODELING IN WILDLAND MANAGEMENT: A STATE-OF-THE-ART ASSESSMENT (VOLUME II - APPENDICES).

Forest Service, Washington, DC.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 949, Price codes: A25 in paper copy, A01 in microfiche. Ecological Research Series, EPA-600/3-77-078, Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Athens, Georgia, July 1977. 567 p, 3 append. EPA-IAG-D5-0660.

Descriptors: \*Watersheds(Basins), \*Forestry, \*Wildland management, \*Non-point source pollution, Effects, Water quality, Erosion, Simulation analysis, Runoff, Planning, Mathematical models, Methodology, Monitoring, Aquatic ecosystem, Predictive models, Systems analysis.

Presented is Volume II of a report which assesses and reviews forestry management activities that can increase the non-point pollutant source potential, the effectiveness of demonstrated control techniques to reduce this potential, the usefulness and reliability of existing non-point source controls, and an evaluation of the water quality data base available for model development and testing. This volume contains: (a) the model evaluation forms that were completed for each model evaluated; (b) the watershed inventory forms that were compiled for each of the inventoried watersheds; and (c) a summary that references the models by number and predictive category. (See also W79-05269) (Bell Graf-Cornell)

W79-05270

#### FEASIBILITY STUDY ON EXECUTIVE PROGRAM DEVELOPMENT FOR BASIN ECOSYSTEM MODELING,

State Univ. of New York Coll. at Plattsburgh. Dept. of Computer Science.

H. Bouver.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 961, Price codes: A06 in paper copy, A01 in microfiche. EPA-600/3-78-034, Ecological Research Series; Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Athens, GA., March 1978. 69 p, 153 ref, 7 append.

Descriptors: \*Simulation analysis, \*Computer programs, \*Feasibility studies, \*Computer models, \*Water quality, \*Interactive graphic display, Systems analysis, Basin-wide, Point source, Nonpoint source, Urban water quality modeling, Graphic

executive program, Programming modules, Database, Data-structure, Computer language.

The feasibility of developing and implementing a complete graphic executive program to automatically interface various basin-wide water quality models for use by relatively inexperienced modelers was examined. Because of a number of problems, including data base management difficulties, the study recommends the development of a 'pilot' version to resolve questions before full-scale implementation of the environmental system is attempted. The executive program should ultimately have the capability to integrate point and nonpoint source models to simulate and analyze the consequences of implementing land use alternatives and pollution control strategies. To reflect accurately the present state of the art, the study examined interactive computer graphics display and software design to automatically interface basin ecosystem submodels. In addition, a literature review was made to assess the state-of-the-art of urban water quality mathematical modeling relative to its modularization for the executive program. Particular attention was addressed to interactive computer graphic display as the medium in which this executive program would be primarily used. (Bell-Graf-Cornell)

W79-05285

#### ALGAE AND WATER POLLUTION,

For primary bibliographic entry see Field 5C. W79-05322

#### PHYSICAL QUALITY AND SEDIMENT TRANSPORT IN DRAINAGE WATER FROM A MANURED AND FERTILIZED CROPPING OPERATION,

Department of Agriculture, Ottawa (Ontario). Animal Research Inst.

N. K. Patni.

Journal of Environmental Science and Health, Vol. 13, No. 3, 1978, p 269-285. 1 fig, 7 tab, 13 ref.

Descriptors: \*Sediments, \*Agricultural runoff, \*Land application, \*Manure, \*Crop production, \*Farm management, \*Greenbelt Farm(Ontario, Canada), \*Water quality control, Water pollution sources, Drainage water, Watersheds(Basins), Streams, Canada, Ontario(Canada), Dissolved solids, Conductivity, Sediment transport, Soil erosion, Snowmelt, Hydrology, Nutrients, Fertilization, Farm wastes, Livestock, Rotations, Cultivation, Data collections.

A three-year investigation (1975-77) of effects on drainage water quality and sediment transport of large-scale plowdown of liquid manure into cropland on 594-ha Greenbelt Farm, a research area at Ottawa, Ontario, Canada, showed that with proper management good drainage water quality can be maintained. Such management practices include: (1) immediate plowdown of manure after application, (2) restriction of manure application to relatively dry periods, (3) provision for manure storage during wet weather and winter, (4) rotation of fields subject to manure application, and (5) application away from stream banks. Most annual sediment transport occurred during snowmelt runoff, and the amount of solids transported from agricultural land was greatly influenced by hydrological flow conditions (longer periods of heavy, turbulent flows in 1976 resulted in greater net transport compared to 1977). Specific conductivity measurements were useful for quick estimates of dissolved solids content in drainage water. Large quantities of liquid manure have been incorporated into the soil every year (mid-April to mid-December) since 1968. Manure was derived 65% from dairy cattle, 30% from sheep, and about 5% from poultry. Four incoming and two outgoing streams were monitored. The cropped area (96% of the basin) is under a 3-5 year rotation of corn and mixed legume-grass, with some small grain. (Lynch-Wisconsin)

W79-05339

#### BALLASTED FLOATING BARRIER BOOM, Conwed Corp., St. Paul, MN. (Assignee).

I. I. Niemi, and K. S. Peterson.

U.S. Patent No. 4,129,989, 5 p, 5 fig, 8 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 3, p 706, December 19, 1978.

Descriptors: \*Patents, \*Oil pollution, \*Water pollution control, \*Water quality control, Floating, Barriers, Oil booms, Containment.

A floating ballasted oil containment boom provides a stable continuous barrier to the passage of petroleum or other contaminants floating on the surface of water. Boom elements are connected end to end by an overlapping joint. The boom is made of a closed-cell flexible plastic foam and is formed to make a longitudinal pocket. The longitudinal pocket is filled with a ballast material having a specified gravity greater than that of the liquid on which it is to float. The ballast material is preferably granular to enable the boom to be rolled up. For containment of certain industrial pollutants other than petroleum which may attack a polyethylene boom, or for use on liquid bodies other than water, other buoyant materials may be used without departing from the spirit and scope of this invention. (Sinha-OEIS)

W79-05376

#### OIL SEPARATION MATERIAL,

British Petroleum Co. Ltd., London (England). (Assignee).

R. J. R. Cairns, and J. M. Howard.

U.S. Patent No. 4,129,499, 5 p, 10 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 2, p 537, December 12, 1978.

Descriptors: \*Patents, \*Oil pollution, \*Water quality control, Water pollution treatment, Water purification, Separation techniques, Coalescence, Dispersion, Coals, Dispersants, Purification beds.

A method for separating oil from water contaminated with oil comprises passing a contaminated water stream through spaced apart purification beds containing solid particles in such manner that the oil coalesces and an oil phase and a water phase are formed. Materials which can be used in particulate form in the purification beds include anthracite, charcoal polystyrene, polyethylene and polypropylene. Such materials, while very useful for coalescing fresh water contaminated with oil, are not particularly effective for treating sea water. It has now been discovered that treating the purification bed packing material with certain polymers improves its coalescing performance with respect to oil-salt water mixtures. The method comprises: contacting the particles with a solution of a dispersant additive; treating the contacted particles with a hydrocarbon activating agent; and/or carrying out both steps simultaneously. (Sinha-OEIS)

W79-05378

#### FLOATING-REFUSE-COLLECTING BOAT,

Mitsubishi Jukogyo Kabushiki Kaisha, Tokyo (Japan). (Assignee).

H. Ogura, H. Asakawa, J. Kondoh, M. Nakamura, and S. Oyaide.

U.S. Patent No. 4,128,068, 5 p, 5 fig, 4 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 1, p 67, December 5, 1978.

Descriptors: \*Patents, \*Water pollution control, \*Water quality control, Skimming, Solid wastes, Flotsam, Jetsam, Ships, Jets, Harbors, Rivers, Equipment, Floating solid wastes, Twin-hull boats.

A floating-refuse-collecting boat of a twin-hulled construction includes a floating-refuse collector located in the water channel formed between the hulls. Main water-jet units are installed on the bows of the hulls for directing jets of water rearward through the water channel for guiding and forcing the refuse afloat in the vicinity of the entrance into the channel and toward the collector. In addition, auxiliary water-jet units are mounted on the hulls rearward of the main water-jet units and in front of the collector to provide jets of water which prevents refuse from flowing out of the collector when the boat moves astern. (Sinha-OEIS)

## Techniques Of Planning—Group 6A

## 6. WATER RESOURCES PLANNING

## 6A. Techniques Of Planning

**MOBILE BAY HYDROGRAPHY UNDER FLOOD STAGE CONDITIONS**, Alabama Univ., University. Dept. of Chemical and Metallurgical Engineering. For primary bibliographic entry see Field 2L. W79-05008

**MATHEMATICAL MODELING OF SURFACE WATER IMPOUNDMENTS, VOLUME: I, AND II**, Resource Management Associates, Lafayette, CA. For primary bibliographic entry see Field 2H. W79-05011

**TRANSIENT SUBSURFACE DRAINAGE ON SLOPING IRRIGATED LAND**, Bechtel, Inc., San Francisco, CA. H. J. Yeh, and L. G. King. Paper No. 78-2037, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 21 p. 7 fig. 15 ref. ASAE, St. Joseph, Michigan.

Descriptors: \*Subsurface drainage, Subsurface drains, \*Irrigated land, Canal seepage, Slopes, Interception, Numerical analysis, Water table, Irrigation, Hydrodynamics.

Parallel subsurface drains on sloping land were studied. Source of water was upslope seepage such as from a canal as well as intermittent irrigation over the drains. The ground surface was treated as a boundary so that both fully and partially saturated flow conditions existed within the soil region under study. The water table location was determined from the numerical solution of hydraulic head as a function of space coordinates. ADI methods were used to solve the basic partial differential equation together with appropriate initial and boundary values. Land slopes of up to 15 degrees from the horizontal were studied. Water table fluctuation and drain discharge were obtained over several irrigation cycles. During recession of the water table following an irrigation, the location of the maximum water table height between the drains moved toward the lower drain. The water table recession following an irrigation was compared with existing theories using only saturated flow for parallel drains on flat land. The results of this study showed the water table height as a function of time to be greater than predicted by existing theories even for quite small slopes. The effects of partially saturated flow and land slope on this result are discussed. (Skogerboe-Colorado State) W79-05052

**INTERACTIVE MULTIPLE OBJECTIVE OPTIMIZATION**, Purdue Univ., Water Resources Research Center. Lafayette, IN. K. J. Musselman, and J. J. Talavage. Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 211. Price codes: A10 in paper copy, A01 in microfiche. Technical Report No 121, February 1979. 196 p. 30 fig. 12 tab, 64 ref, 3 append. OWRT B-083-IND(10).

Descriptors: \*Optimization, \*Urban drainage, \*Detention reservoirs, Algorithms, Storm water, Reservoir storage, Drainage system, Drainage basin, Nonlinear programming.

Decision problems often arise in which several, non-commensurate and conflicting objectives must be considered simultaneously. This report is concerned with first investigating a general nonlinear class of these problems and then developing a means of solving problems found in this class. The results are divided into four related areas: (1) identifying properties and relationships which exist

within this class of problems and which prove useful to their resolution, (2) developing a user-oriented algorithm, using these properties, to solve nonlinear multiple objective optimization problems, (3) applying the algorithm to a representative problem and (4) modifying the algorithm to address discrete nonlinear multiple objective optimization problems. A decision problem concerned with the expected storm drainage needs of an urban subbasin is analyzed by means of the algorithm. The problem involved minimizing various pollutant loads and costs by adjusting the drainage systems local detention storage capacity, maximum treatment rate and maximum allowable overflow rate. Convergence results are shown for several tradeoff policies. The tradeoff algorithm is modified to resolve the question of how to find integer solutions to the nonlinear multiple objective optimization problems. The peculiar difficulties involved with directly applying the continuous version of the algorithm are discussed in detail. W79-05092

**WATER-QUALITY INVESTIGATION OF THE VACHE GRASSE CREEK WATERSHED, SEBASTIAN COUNTY, ARKANSAS**, Geological Survey, Little Rock, AR. Water Resources Div. T. E. Lamb. Geological Survey open-file report 78-903, 1978. 25 p, 2 fig, 5 tab, 11 ref.

Descriptors: \*Baseline studies, \*Water quality, \*Water analysis, \*Watershed management, Chemical properties, Topography, Geology, Physical properties, Sampling, Arkansas, Pre-Soil Conservation Service programs, \*Vache Grasse Creek watershed, Sebastian County.

The results of a 1-year study in the upper Vache Grasse Creek watershed, Sebastian County, AR, are presented to document surface-water quality conditions before implementation of Soil Conservation Service programs. Analysis of samples collected at four sites showed that during periods of warm weather several of the parameters sampled produced unusually high or low values that indicated possible water-quality problems. Low dissolved-oxygen concentration, high nitrogen and organic carbon concentrations, and high coliform bacteria counts were at sampling sites upstream from the Greenwood water-supply lake. Sampling in and downstream from the lake indicated that the quality of the water passing through the lake was improved significantly. However, sampling in the lake indicated that there is a large layer of water with low oxygen concentration and a buildup of phosphorus, iron, manganese, and some other metals in the bottom ooze. (Woodard-USGS) W79-05158

**MATHEMATICAL MODELING OF WATER QUALITY**, Cambridge Univ. (England). Control and Management Systems Div. M. B. Beck. CP-78-10. Summary Report of a IIASA Workshop, September 13-16, 1977, Laxenburg, Austria. International Institute for Applied Systems Analysis, Laxenburg, Austria, October 1978. 50 p, 50 ref.

Descriptors: \*Water quality, \*Mathematical models, \*Systems analysis, Rivers, Lakes, Reservoirs, Estuaries, Pollutants, Planning, Management, Ecology, Design, Eutrophication, Nitrogen cycle, Real-time, France, Rhine River(Germany), Hydrophysics.

Summarized are the proceedings of an IIASA Workshop on Water Quality Modeling held at Laxenburg, Austria, September 13-16, 1977. The Workshop was held as an initial activity within IIASA's research Task on Models for Environmental Quality Control and Management. In convening the Workshop, the organizers invited participants to express their views on the current state of mathematical modeling of water quality. They were encouraged also to speculate on future directions for the subject and to make recommendations for the ways in which such research could be

W79-05380

**PROCESS FOR PURIFYING WASTE WATER OBTAINED BY A PAPERMAKING PROCESS**, Lila Edet Aktiebolag (Sweden). (Assignee). For primary bibliographic entry see Field 5D. W79-05386

**POLLUTING OIL RECOVERY APPARATUS**, P. J. Strain. U.S. Patent No. 4,120,793, 4, 2 fig, 7 ref; Official Gazette of the United States Patent Office, Vol. 975, No. 3, p 1102, October 17, 1978.

Descriptors: \*Patents, \*Oil pollution, \*Oil spills, \*Water pollution treatment, \*Water quality control, Separation techniques, Ships, Equipment, Sluice gates, Baffles, Flow, Oil recovery.

After a series of booms has enclosed or partly enclosed a patch of spilled oil on the water, the recovery ship, which has booms attached to the sides, advances bow forward into the oil. A series of sluice gates are provided at the bow into which the oil flows. The oil with water drawn into the sluice gates of the ship is pumped into a heated conduit directed within the ship toward its stern. Within the conduit a series of baffles are deployed as valves to allow water to pass along the conduit but having means to draw off any oil which has sought its natural position on the surface of the flowing water-oil mixture in the conduit. As a final separation means, a U bend is provided to the conduit travelling downward into the bottom of the ship and upwards again to a water discharge outlet. As the mixture is allowed periodically to rest in the U bend the remaining oil in the mixture settles in the upper portion of the U bend where it is extracted. More than one U bend can be provided in each conduit if necessary. (Sinha-OEIS) W79-05390

**CONTROL OF OIL POLLUTION BY REMOTE SENSING ALONG THE SHORES OF FRANCE**, French Embassy, Washington, DC. For primary bibliographic entry see Field 7B. W79-05392

**REMOTE SENSING OF THE OCEANS - A REVIEW**, Aircraft Research and Development Unit, Edinburgh (Australia). For primary bibliographic entry see Field 7B. W79-05394

**IMAGE ENHANCEMENT OF SIDE-SCAN SONAR MAPPING**, California Univ., Santa Barbara. For primary bibliographic entry see Field 7B. W79-05395

**THE USE OF LANDSAT IMAGERY FOR MARINE POLLUTION STUDIES**, Singapore Univ. For primary bibliographic entry see Field 7B. W79-05396

**STORMWATER MANAGEMENT MODEL: TRANSFER OF TECHNOLOGY**, Environmental Protection Agency, Washington, DC. Office of Research and Development. For primary bibliographic entry see Field 5B. W79-05412

**VARIABILITY OF ANNUAL NUTRIENT AND SEDIMENT DISCHARGES IN RUNOFF FROM OKLAHOMA CROPLAND AND RANGELAND**, Agricultural Research Service, Durant, OK. Water Quality Management Lab. For primary bibliographic entry see Field 5C. W79-05429



## Group 6A—Techniques Of Planning

organized in collaboration with IIASA. The report on the Workshop is divided broadly into two sections: the first deals with key themes and salient problems of water quality modeling; the second reproduces the concluding statements of nine ad hoc working groups established during the Workshop. These working groups considered a number of specific areas, such as deep lakes and reservoirs, the impact of toxic pollutants, systems methods in model development and analysis, and so forth. An intermediate section of the report briefly considers future perspectives in water quality modeling. In the final section, particular reference is made to the Institute's plans for water quality model development and application in particular case studies. (Bell Graf-Cornell)  
W79-05273

## COLLECTIVE DECISION MAKING IN WATER RESOURCE PLANNING,

Virginia Univ., Charlottesville.  
R. Burke, III, and J. P. Heaney.  
Lexington Books, D.C. Heath Company, Lexington, Massachusetts, (and Toronto, Canada) 1975. 260 p, 23 fig, 22 tab, 673 ref.

Descriptors: \*Water resources, \*Planning, \*Decision making, \*Collective action, Methodology, Mathematical models, Systems analysis, Equations, River basins, Management, General theory, Synergistic behavior, Complexity, Antireductionism, Social systems, Holistic reasoning.

Basically, this book assumes that contemporary water resource problems are actually symptoms of another more fundamental malady: the lack of a general, over-arching set of guiding principles for water-related planning and decision making. It is assumed also that theory and concept are the best guides to reasoned action. 'Synergistic behavior' and 'Complexity' are two primary characteristics of the general water resource situation and must be addressed as we develop theories and methodologies. In order that the basic synergism of the water resource system be given proper viability, these theories and methodologies must rest on a fundamental reasoning from whole-to-part. For this book, a definition of three different levels of complicatedness/complexity is given. The book moves from describing the largest systems to probing deeper into sublayers. Three additional concepts from a unifying thread through each chapter: systems, structure, and process. Specifically, the eight chapters herein consider: (1) the disparity between capabilities of existing planning and decision models and the requirements of the external planning environment; (2) an integrating framework, using Parsons' 'general theory of action'; (3) current systems thinking in planning theory, drawing on Ozbekhan's 'general theory of planning, and showing how water resource planning meshes with the larger system, the societal overlay; (4) introducing 'process' into the analysis as a means of giving life to those broader structural concepts (9 bipolar dimensions are used to characterize any decision situation); and (5) the application of simulation to a water quality problem in hypothetical Bow River Valley. (Bell-Graf-Cornell)  
W79-05274

## A MULTIDISCIPLINARY TRANSFER MODEL FOR WATER MANAGEMENT KNOWLEDGE TRANSFER IN DEVELOPING COUNTRIES,

Colorado State Univ., Fort Collins. Dept. of Economics.  
J. Eckert.  
In: Water Knowledge Transfer. Volume 1, Proceedings of the Second International Conference on Transfer of Water Resources Knowledge, June 1977, Fort Collins, Colorado. N.S. Grigg, et al., Eds., Water Resources Publications, Fort Collins, Col., 1978, p39-63.

Descriptors: \*Water management (Applied), \*Transfer knowledge, \*Multidisciplinary transfer model, \*Developing countries, Farms, Economics, Agriculture, Water loss, Design, Programs, Technology, Efficiencies, Transfer process, Data sources, Data sources, Ditches, Information needs, Systems analysis.

Rural economic vitality and growth depend very largely on agricultural productivity. Efficient on-farm water management contributes to rural economic growth, in at least four ways, avoiding: (1) wasted or poorly-applied water for providing soil moisture; (2) inefficient transition to a modern agricultural system; (3) much of the annual variability in yields; and (4) excessive loss in delivery and application. Thus there is considerable information on both theoretical and practical aspects of water management which is vitally needed by farmers in developing countries today. This paper develops a process whereby this information can be assembled, evaluated by certain criteria, and used to build improved water management practices which can be widely adopted. Needed is an incentive structure that stresses other things than income maximization and a constraining institutional environment. Suggested is such a structure, including the types of information needed, the sequence of analyses and actions that must be considered, and a description of some of the possible linkages between subcomponents. The transfer process developed herein draws on concepts from agricultural engineering, agronomy, agricultural economics, sociology and political science. Presented is a decision model which draws heavily on the experience of Colorado State University's water management project in Pakistan. The model's principle limitation is its restricted applicability to areas of abundant water supply such as the humid tropics. (See also W79-05409) (Bell-Graf-Cornell)  
W79-05411

## 6B. Evaluation Process

## CONTINUOUS SIMULATION FOR WATER QUALITY PLANNING,

Hydrocomp, Inc., Palo Alto, CA.  
A. S. Donigian, Jr., and R. K. Linsley.  
Water Resources Bulletin, Vol. 15, No. 1, p 1-16, February 1979. 9 fig, 3 tab, 15 ref. OWRT C-6134(5215)(3), 14-31-0001-5215.

Descriptors: \*Water quality control, \*Alternative planning, \*Simulation analysis, Economic impact, Benefits, Methodology, Evaluation, Costs, Decision making, Aeration, Watersheds (Basins), Economic efficiency, Cost-effectiveness, Dissolved oxygen, Systems analysis.

Described is a methodology for the evaluation of water quality plans analogous to procedures used in flood control planning, where flood damage frequency curves provide the basis for determining flood control benefits. The proposed method uses continuous water quality simulation to develop long-term information from which water quality frequency curves can be obtained. This frequency information allows the evaluation of the impact of proposed water quality control plans taking into consideration the variable nature of the water resource. Using treatment costs and other economic indicators of water quality, the frequency information can be used to estimate the cost-effectiveness and economic efficiency of alternative plans. The method is demonstrated in a semihypothetical environment; real hydrologic and climatic characteristics are assigned to a hypothetical watershed configuration. Alternative management plans are simulated and analyzed for both physical and economic impacts. The advantages of continuous simulation and its use in water quality planning are explored. (Bell-Graf-Cornell)  
W79-05010

## DEFINING UPPER LIMITS TO GROUND-WATER DEVELOPMENT IN THE ARID WEST,

Montana State Univ., Bozeman.  
For primary bibliographic entry see Field 4B.  
W79-05271

## WATER PRODUCTION FUNCTIONS FOR IRRIGATED AGRICULTURE,

Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agricultural Economics.

For primary bibliographic entry see Field 3F.  
W79-05275

## EVALUATION OF PROPOSED STORAGE SITES,

Woodward-Clyde Consultants, San Francisco, CA.  
R. L. Keeney.  
Operations Research, Vol. 27, No. 1, p 48-64, January-February 1979. 4 fig, 6 tab, 4 ref.

Descriptors: \*Pumped storage, \*Sites, \*Ranking, \*Screening, \*Preference structure, \*Sensitivity analysis, Hydroelectric generation, Surface waters, Groundwater, Transmission lines, Evaluation, Equations, Risks, Uncertainty, Scaling factors, Utility functions, Invariant value tradeoffs, Ecological impacts, Costs, Technological concerns, Environmental aspects, Economic concerns, Decision making, Southwest US, Mathematical models, Systems analysis.

Screening models and on-site visits by a team composed of engineers, geologists, and biologists were used to identify ten sites in the Southwest suitable for developing a pumped storage facility with a 600 MW capacity. This paper discusses the decision analysis used to rank the sites. The study included the consideration of economic, environmental, and technological concerns relating to the sites and their required transmission lines. Using sensitivity analyses, factors critical to the ranking were identified: uniqueness of the riparian community; uncertainties; and changes in the value tradeoffs, risk attitude and problem definition. (Bell-Graf-Cornell)  
W79-05277

## ECONOMICS OF IRRIGATION,

Nebraska Univ., Lincoln. Dept. of Agricultural Economics.  
For primary bibliographic entry see Field 3F.  
W79-05292

## AN ECONOMIC VALUATION OF RECREATIONAL CLAMMING IN MASSACHUSETTS,

Massachusetts Univ., Amherst. Dept. of Food and Resource Economics.  
R. W. Smith, J. M. Conrad, and D. A. Storey.  
Research Bulletin No. 654, Massachusetts Agricultural Experiment Station, April 1978. 98 p, 7 fig, 30 tab, 19 ref, 3 append.

Descriptors: \*Value, \*Clamming, \*Recreation demand, \*Massachusetts, \*Economics, \*Planning, \*Regulation, \*Willingness-to-pay, Permits, Clams, Surveys, Intertidal areas, Coasts, Resource allocation, Ipswich (MA), Orleans (MA), Scituate (MA), Cost-benefit analysis, Resource management, Mya arenaria, Mercenaria mercenaria, Ensis directus, Fisheries, Mathematical studies, Water pollution effects, Economic efficiency, Decision-making, Quahogs, Soft-shelled clams.

An opinion survey of 267 clamming permit holders (pertaining to 1975) in the Massachusetts towns of Ipswich, Scituate, and Orleans, demonstrated the feasibility of establishing dollar estimates of the value of recreational clamming. This nonmarketed good previously has been described only in terms of participant number and harvest estimates. Willingness to pay for, or to surrender permits were compared with town expenditures for regulation programs. The research objective was to improve planning and decision-making in shellfish resource management. The estimates must be considered only approximations, however, since they do not reflect actual market conditions; in particular, willingness to pay values are probably underestimated. 1974 expenditures for shellfish regulation were \$30,000 in Ipswich, \$20,000 in Orleans, and \$5,600 in Scituate. Scituate's expenditures clearly were economically justified when compared with the \$20,400 willingness-to-pay value of its clam resources; Scituate had no commercial shellfisheries in 1975. \$5,100 in permit fees were collected from nonresidents, and the remaining \$500 in net expenditures compared favorably with \$11,700 in resident benefits based on their willingness to pay.

Commercial harvests in Orleans and Ipswich 5-7 times larger than noncommercial harvests complicated the analysis, but recreational program expenditures clearly were economically justified. This paper also discusses clam species, ranges, and harvests; permit fees, restrictions, and water pollution. (Lynch-Wisconsin)  
W79-05316

**A MODEL FOR COST OPTIMIZATION OF BARGE SHIPMENTS,**  
Missouri Univ.-Rolla. School of Engineering.  
For primary bibliographic entry see Field 6C.  
W79-05317

**A 'PUTTY-CLAY' APPROACH TO AGGREGATION OF PRODUCTION/POLLUTION POSSIBILITIES: AN APPLICATION IN DAIRY WASTE CONTROL,**  
California Univ., Berkeley.  
L. J. Moffitt, D. Zilberman, and R. E. Just.  
American Journal of Agricultural Economics, Vol 60, No 3, p 452-459, August 1978. 2 fig, 3 tab, 21 ref. (UCAL-WRC-W-536).

Descriptors: \*Santa Ana River basin(CA), \*Putty-clay approach, \*Economics, \*Dairy industry, \*Water pollution control, \*Pollution taxes(Charges), \*Standards, \*Methodology, Water quality standards, California, River basins, Regulation, Industrial wastes, Waste water disposal, Water pollution sources, Analytical techniques, Aggregates, Industrial production, Policy, Manure, Political constraints, Optimization, Pollution abatement, Incentives, Mathematical models, Model studies.

Taxes would be more effective than applied standards in controlling pollution caused by manure-loaded dairy wash water in California's Santa Ana River basin; this finding is borne out by use of the theoretical 'putty clay' production framework (Johansen, 1972), in which the relationship between aggregate economic variables and environmental policy instruments is assessed with empirical data. Since the cost to the industry would be greater with the tax approach, however, redistribution of tax revenues back to the industry may be necessary as a political incentive for policy acceptance. The approach used in this paper concentrates on the variability of production techniques and parameters across farms, instead of the traditional method of using the response of a representative firm to pollution controls as a measure of industry response. With the framework developed by Johansen, aggregate relations incorporating the response of individual firms can be derived for the short run. This paper demonstrates use of the procedure to determine short-run relations between environmental policy goals and instruments, and to determine optimal taxes and standards. The 'putty-clay' concept of the framework, which assumes that capital goods (such as machinery) are so specialized that their input-output ratio cannot be changed after installation, justifies aggregation based on empirical estimation of the distribution of input-output coefficients. (Lynch-Wisconsin)  
W79-05318

**ENDOGENOUS BIAS IN TECHNICAL PROGRESS AND ENVIRONMENTAL POLICY,**  
Temple Univ., Philadelphia, PA. Dept. of Economics.  
R. A. McClain.  
The American Economic Review, Vol 68, No 4, p 538-546, September 1978. 5 fig, 17 ref.

Descriptors: \*Pollution abatement, \*Environmental policy, \*Technology, \*Economic growth, \*Economics, \*Mathematical models, \*Environmental effects, Costs, Model studies, Pollution taxes(Charges), Regulation, Standards, Political constraints, Zero pricing, Natural resources, Pollutants, Policy, Labor, Wages.

The likelihood that technical progress, because of market forces, degrades the environment is confirmed by means of two models representing different approaches to the impact of economic variables

on labor and capital productivity, and on pollution per unit of output. The two models suggest similar conclusions for environmental policy: (1) zero pricing of environmental amenities means that pollution increases more rapidly than production; and (2) if pollution is to be stabilized in a growing economy, the price of pollution must not only be positive but flexible upward, and must rise at least at the same rate as labor productivity and wages. The approaches used were: (1) the innovation-possibility frontier approach, and (2) Nordhaus' more general 'isotech' approach. An isotech is the set of all techniques attainable at the same given cost, and the family of isotechs defines the technological opportunities available at a particular time. To fulfill the flexibility requirement for pollution prices, quantitative regulation may be the best politically feasible approach to environmental management. Direct legislation of such penalties as pollution taxes does not appear to provide the appropriate flexibility. A market for pollution rights or the Baumol approach would provide such flexibility. (Lynch-Wisconsin)  
W79-05319

**SLUDGE TO LAND—ECONOMIC CONSIDERATIONS FOR WATER AUTHORITIES,**  
Water Research Center, Medmenham (England).  
Medmenham Lab.  
R. W. Bayley, and G. Hoyland.  
Water Services, Vol 82, No 990, p 531-535, August 1978. 4 fig, 5 tab.

Descriptors: \*Land application, \*Sewage sludge, \*Sludge disposal, \*Sludge treatment, \*Economics, \*Costs, Water management, Sewage treatment, Fertilization, Agriculture, Crop production, Methodology, Alternative costs, Sewage lagoons, Lime, Centrifugation, Thickening, Stabilization, Sludge digestion.

Disposal costs were evaluated for five methods of treating sewage sludge prior to utilization on farm land were evaluated: (1) untreated sludge, (2) stabilization with lime, (3) anaerobic digestion in treatment lagoons, (4) gravity thickening followed by digestion, and (5) centrifugation followed by digestion. At small works (20,000 population) disposal of untreated or lime-stabilized sludge may be most economical. At larger works (100,000 population) methods involving digestion are economically competitive, especially for disposal of a thin sludge to a distant site. Centrifuging before digestions can be economical on a large scale for thin sludge. Lagooning is the most economical treatment method at large works (500,000 population) and very competitive at medium-sized works. In some areas untreated liquid sludge is acceptable for farm use, while in others some form of stabilization or conditioning is preferred. This variation is reflected in disposal costs. Overall costs were estimated from capital and operating costs of the constituent processes, and include costs of treating recycled supernatant liquors. Comparisons were evaluated on the basis of unit costs (pounds sterling/dry solids from the primary sedimentation tank) calculated from the total annual cost and rate of production of dry sludge solids. Cost figures are provided. (Lynch-Wisconsin)  
W79-05320

**THE ECONOMIC VALUE OF IRRIGATION WATER IN THE WESTERN UNITED STATES: AN APPLICATION OF RIDGE REGRESSION,**  
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.  
M. D. Frank, and Bruce R. Beattie.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 610. Price codes: A07 in paper copy, A01 in microfiche. Texas Water Resources Institute, Texas A and M University Technical Completion Report No. 99, March 1979. 195 p, 20 tab, 13 fig, 5 append, 59 ref. OWRP A-034-TEX(1). 14-34-0001-6045, 7091, 7092, 8046.

Descriptors: \*Irrigation water, Water demand, Regression analysis, \*Water values, Western United States.

This study reports marginal water values and demand elasticities for eleven major irrigated regions in the West. Agricultural output in each region was hypothesized to take the form of a multiplicative function with nine domain variables—irrigation water applied, value of land and buildings, hired labor expenditures, fuel and lubricant expenditures, fertilizer and lime expenditures, feed expenditures, value of machinery inventory, value of livestock inventory and miscellaneous expenditures. Using 1969 Census of Agriculture data, each regional function was estimated using both OLS and ridge regression. As expected, parameter estimates under OLS were highly unstable due to multi-collinearity. One-third of the estimated coefficients took on nonsensical signs and the standard errors were generally high. For the ridge analysis, all parameter estimates, except one, took on the expected positive sign and the standard errors were decreased in every case. Returns to scale varied from a high of 1.200 in the Northwestern Ogallala to a low of .887 in the Lower Rio Grande Basin. From the fitted production functions, irrigation water demand was derived for alternative lengths run. Generally, water demand was found to be slightly elastic with the more elastic demand in the Desert Southwest and Upper Colorado Basin. Marginal irrigation water values were estimated for 1969 at the respective regional mean values of water usage, fixed input levels and variable input prices.  
W79-05399

**KENNEBEC RIVER CORRIDOR PLAN -- A MANAGEMENT PLAN FOR A REJUVENATED RESOURCE,**  
North Kennebec Regional Planning Commission, Winslow, ME.  
E. L. Flynn, Jr.  
September 1974. 100 p, 11 fig, 5 append. OWRP C-4297(No. 9047)(1), Vol.1.

Descriptors: \*Water resources development, \*River basin development, \*Water resources management, \*Maine, \*Kennebec River, Water conservation, Long-term planning, Projections, Area redevelopment, Surveys, Social aspects, Regional development, Environmental effects, Ecology, Recreation, River basin commissions, Hydroelectric power, Wildlife, Habitats, Water policy, Comprehensive planning.

The Kennebec River Corridor Plan was drafted by Northern Kennebec River Planning Commission to maximize the potential for multiple use of land and water resources while minimizing destruction of the environment of the corridor. At present, the Kennebec River is a moderately developed, industrial watershed, managed primarily for maximum hydroelectric power generation. Despite this, much of the river shore is undeveloped, because heavy pollution and constant presence of logs have reduced its desirability for development. Two segments of the river were recommended for general recreational uses, the southern part of Wyman Lake and the pool behind Shawmut Dam in Fairfield. It is suggested that state, municipalities, or other authorities evaluate these areas for park facilities. Three areas were identified as having significant value for wildlife and low impact recreational use. Much of the undeveloped corridor consists of floodplains, steep slopes, assorted poor soils and significant wildlife areas, and, on this basis, is recommended to remain open. In addition, to a general analysis of the area, the plan divides the river into small, relatively homogeneous segments for more detailed analysis of natural resources and more precise management recommendation. Specific recommendations were made in each segment concerning areas such as historic sites, wildlife habitats, and significant physical features. Recommendations are aimed at landowners, local governments, and state agencies who will continue to manage the corridor. (See W79-05403 thru W79-05407) (Majtenyi-IPA)  
W79-05402

**KENNEBEC RIVER CORRIDOR PROJECT -- APPENDIX I: DEMOGRAPHY,**  
North Kennebec Regional Planning Commission,



## Field 6—WATER RESOURCES PLANNING

### Group 6B—Evaluation Process

Winslow, ME.  
E. L. Flynn, Jr.  
May 1975. 31 p, 2 fig, 16 tab. OWRT C-4297(No. 9047)(1), (2).

Descriptors: \*River basin development, \*Kennebec River, \*Water resources management, \*Demography, \*River basin commissions, Surveys, Projections, Long-term planning, Human populations, Project planning, Flood plains, Community development.

A demographic analysis was carried out to help in formulation of the North Kennebec River Corridor Project. The analysis was conducted primarily to outline the regional trends in population movement and housing development for the region's municipalities which are responsible for coping with population dynamics. It was also aimed at helping the Regional Planning Commission and other state and local organizations to identify problem areas or potential problem areas that may need special attention or assistance. Analysis indicated that the region is more populated with relatively old and young people rather than by middle aged people mainly because of lack of opportunity for middle aged wage earners. Also, young females are more abundant than young males who have left the region seeking better job opportunities. In recent decades, the area has been suburbanized both by people moving from urban areas and from rural fringe areas. Also, people tended to migrate to the lake communities. A moderate rate of growth is projected for the region, about 3% per decade, with much taking place near employment centers and near existing water and sewer systems. Lake development is expected to decline as the amount of vacant developable shoreland is used up. This may lead to more river front development but, because of limitations caused by low lying flood plains and wet lands and steep banks, the amount of this development is difficult to predict. (See also W79-05402) (Majtenyi-IPA)  
W79-05403

**KENNEBEC RIVER CORRIDOR PROJECT - APPENDIX II: WATER RESOURCES,**  
North Kennebec Regional Planning Commission, Winslow, ME.  
E. L. Flynn, Jr.  
May 1975. 56 p, 2 tab. OWRT C-4297 (No. 9047) (1), Vol. 3.

Descriptors: \*River basin development, \*Kennebec River, \*Water resources management, \*Water supply, \*Water quality, Lakes, River basins, Groundwater, Water pollution, Watersheds(Basins), Watershed management, Water utilization, Water pollution control, Treatment facilities, Stream pollution, Groundwater resources, Evaluation, Projections, River basin commissions, Hydrologic data.

Evaluating data on the adequacy of supply and quality of the waters throughout the watershed was a major component of the Kennebec River Corridor Project. The focus was on correlating existing and needed water resources data to land use management. Data were analyzed concerning six aspects of the area's water resources: water supply, stream water quality, lake water quality, groundwater quality, pollution sources in the Kennebec River and tributaries, and future water quality. The following conclusions were reached: (1) the region's water supply is more than adequate to meet expected needs far into the future but water quality may require increased protection; (2) stream water quality is improving substantially throughout the watershed except in the upper Sebasticook River Valley; (3) deteriorating lake water quality is the region's most pressing water problem for which there is a considerable amount of data but few currently acceptable solutions; (4) groundwater quality remains an unknown entity, but may become a significant issue in the future; (5) all major point sources of pollution will be receiving some form of treatment by 1976 but the Sebasticook River watershed is woefully lacking in treatment facilities; (6) future water quality improvement in the Kennebec River will depend on decreasing pollution from non-point sources and

improving existing treatment plant effectiveness by reducing storm water overloading. (See W79-05402) (Majtenyi-IPA)  
W79-05404

**KENNEBEC RIVER CORRIDOR PROJECT - APPENDIX III: FLOW REGULATION,**  
North Kennebec Regional Planning Commission, Winslow, ME.  
E. L. Flynn, Jr., G. Bernstein, and D. Meagher.  
March 1978. 12 p, 4 tab. OWRT C-4297(No. 9047)(1) Vol. 4.

Descriptors: \*River basin development, \*Kennebec River, \*Flow control, \*River flow, \*Water supply, Dams, Hydroelectric power, Lakes, Water utilization, Natural resources, Water resources development, Water resources management, Evaluation, Safety factors, River basin commissions, Multiple purpose reservoirs, Project purposes.

Flow regulation of the Kennebec River was studied and analyzed and some of the issues related to flow regulation are introduced. Data of ten hydroelectric dams and 14 major storage reservoirs are tabulated. The Kennebec River has changed from a single use river, basically industrial, to one that can be used for multiple purposes since log drives were discontinued in 1976. Major impoundments on the Kennebec are regulated by the Kennebec Water Power Company according to a flow management plan and judgments based on years of experience by the river management company. The Maine Department of Inland Fish and Wildlife is currently satisfied with the balance achieved between maintenance of lake levels and river flow in the Kennebec basin. Many small dams have been abandoned by their original owners and are deteriorating, thereby posing a potential safety hazard. The following recommendations were made: (1) flow regulation of the Kennebec river should continue to consider multiple use when making management decisions; (2) future proposals for hydroelectric generating or pump storage facilities should be evaluated for their impact on the multiple use capacity of the river; and (3) safety standards for dams should be established and a system for maintaining and managing a dam should be developed involving those people who directly benefit from the particular dam. (See also W79-05402) (Majtenyi-IPA)  
W79-05405

**KENNEBEC RIVER CORRIDOR PROJECT - APPENDIX IV: FLOODING,**  
North Kennebec Regional Planning Commission, Winslow, ME.  
E. L. Flynn, Jr., G. Bernstein, and D. Meagher.  
Revised, February 1978. 46 p, 7 fig, 5 tab, 2 append. OWRT C-4297(No. 9047)(1) Vol. 5.

Descriptors: \*River basin development, \*Flood control, \*Kennebec River, \*Flood protection, Water resources development, Flood plains, Rivers, Flood damage, Flood forecasting, Dams, Flood plain insurance, Mapping, Contours, Planning, Government supports, Governmental interrelations, Administration, Institutions, Monitoring, Water resources management, River basin commissions.

The problem of flooding in the Kennebec River corridor was investigated beginning with a history of flooding and the influence of basin characteristics and tributary flow on flood behavior along the mainstream. Damage is described and some projections for the future are made. Methods of delineating the expected area of inundation are illustrated and management tools for controlling development within this area are discussed. Although monitoring, issuing advisories and warnings, and exercising the little control afforded by hydroelectric dams have been the traditional means to control flooding, more effective management should involve controlling flow with existing multi-purpose dams and regulations of development within the floodplain itself. Problems to be solved include: (1) delineation of the actual floodplain which could be carried out by unifying the multitude of flood zones into a uniform zone that would apply in all

regulatory and permit situations; (2) the multitude of requirements, standards, and procedures for local review imposed by Flood Insurance Programs and others which could be dealt with more efficiently with assistance from the regional planning commission in the form of model ordinances and review procedures, direct consultation, and workshops; and (3) the attitude of municipalities toward the state and Federal programs which they implement. It is recommended that the entire flood management program could be more equitably applied and smoothly administered if integrated into a comprehensive plan with town-wide zoning. (See also W79-05402) (Majtenyi-IPA)  
W79-05406

**KENNEBEC RIVER CORRIDOR PROJECT - APPENDIX V: MANAGEMENT PLAN,**  
North Kennebec Regional Planning Commission, Winslow, ME.  
E. L. Flynn, Jr., G. Bernstein, and D. Meagher.  
April 1977, revised by A. Cox, April 1978. 14 p. OWRT C-4297(No. 9047)(1) Vol. 6.

Descriptors: \*River basin development, \*River basin commissions, \*Management, \*Kennebec River, Water resources management, Flood plains, Aquifers, Scenery, Recreation, Water resources development, Land management, Comprehensive planning, Environmental effects, Environmental control, Rivers, River basins, Natural resources.

A management plan for the Kennebec River Corridor was designed to serve the dual purpose of discussing the alternative management options for the river corridor while providing a commentary on some of the land use management laws and techniques currently in use in Maine. The basic corridor management scheme requires: (1) acquiring title or interests of critical resources that deserve absolute public protection, such as valuable natural, scenic, historic, or recreational areas; (2) promoting proper resource management on privately owned land to enhance the multiple use value of the corridor; (3) utilizing effective land use regulations to protect fragile areas, such as flood plains, steep slopes, aquifers, and wetlands; and (4) guiding growth and development into most suitable and desirable areas. Before this plan can be carried out, an inventory of all corridor resources must be prepared so that evaluation is possible. Also, close contact with landowners is recognized as of great importance in success of the plan. The goal is to develop a landowner with an environmental conscience and the knowledge to utilize land resources with minimum adverse impacts. (See also W79-05402) (Majtenyi-IPA)  
W79-05407

**INTEGRATING WATER RESOURCES AND LAND USE PLANNING,**  
Utah Water Research Lab., Logan; and Utah Center for Water Resources Research, Logan.  
J. Mulder, K. R. Kimball, D. T. Larson, L. D. James, and L. R. Rovig.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 643. Price codes: A06 in paper copy, A01 in microfiche. Water Resources Planning Series UWRL/P-79-01, January 1979. 114 p, 11 fig, 9 tab, 2 append. OWRT C-6279(5227)(1). 14-34-0001-5227.

Descriptors: \*Land use, \*Planning, Model studies, Institutions.

Information and recommendations were developed pertaining to the integrating of water resource and land use planning at a conceptual level. In the accomplishment of this goal, the report acts as a vehicle of information transfer to facilitate recognition of the interrelationships between land use and water resources planning by practitioners in both areas. The approach that was used includes six basic components: (1) the clarification of current planning theory as it pertains to both water and land use planning, (2) analysis and review of historical and current land use planning practices, (3) analysis and review of historical and current water planning practices, (4) identification of problems and concepts which would affect the integration of

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land and water planning, (5) the design of a conceptual framework (the IRUM model) which would facilitate the integration of land and water planning, and (6) a case study of a selected planning region for small scale applications of the IRUM model. In connection with the case study, a general population survey was taken to identify social and environmental values, land and water use preferences, and other conditions which would affect an integrated planning effort. The recommendations cover institutional issues such as culture, law, and organizational arrangements, and also methodological issues such as conceptual framework development and procedural problems which will confront actual efforts to integrate land and water resource planning.  
W79-05408

**CONNECTICUT RIVER DIVERSION; A CASE STUDY IN WATER ALLOCATION POLICY,**  
Massachusetts Univ., Amherst. Water Resources Research Center.  
E. R. Kaynor.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 785, Price codes: A11 in paper copy, A01 in microfiche. Publication No. 98, 1978. 175 p, 16 tab, 170 ref, 4 append. OWWR C-7178 (No. 6215) (2), 14-34-0001-6215.

Descriptors: \*Connecticut River, \*Diversion, \*Water allocation, Inter-basin transfers, Planning, Water policy.

Water allocation problems in the Northeast were investigated using current plans for interbasin transfers from the Connecticut River Basin as a topical focus. It was found that what appeared to be political controversy between areas of water export and import was, in reality, due mainly to absence of answers to key planning questions and to inconsistent data used to support diversion plans. Existing democratic institutions, while less than ideal, would be adequate to set allocation policy and to implement rational allocation plans if a means could be found to improve planning and data acquisition. A planning format featuring advocacy planning by protagonists moderated by impartial professionals is suggested. (Godfrey-Mass)  
W79-05414

**6C. Cost Allocation, Cost Sharing, Pricing/Repayment**

**DISTRIBUTING REGIONAL SERVICES COSTS,**  
Environmental Protection Agency, Cincinnati, OH.

L. A. Rossman, and P. A. Graham.  
Journal of the Urban Planning and Development Division, Proceedings of the American Society of Civil Engineers, Vol. 105, No. UP1, p 51-62, January 1979. 1 fig, 2 tab, 17 ref.

Descriptors: \*Cost analysis, \*Cost distribution, \*Regional planning, \*Services, Water resources, Game theory, Linear programming, Optimization, Constraints, Equity maximization, Stability maximization, Cost minimization, Equations, Systems analysis.

Regional systems to provide urban services must be designed not only on the basis of cost effectiveness but also with regard to a proper distribution of costs among the participants. The cost distribution should be equitable and stable (in the sense that incentives for groups to break away and form separate systems are minimized). Concepts of n-person cooperative game theory are utilized to develop quantitative measures of equity and stability. These measures are incorporated into linear programming models that allow explicit equity-stability tradeoffs to be made in distributing the costs of the least-cost regional service plan. Examples that demonstrate the use of the methods are provided. (Bell-Graf-Cornell)  
W79-05276

**THE GERMAN FEDERAL LAW ON WASTEWATER CHARGES,**  
Technische Univ., Darmstadt (Germany, F.R.).  
For primary bibliographic entry see Field 6E.  
W79-05315

**A MODEL FOR COST OPTIMIZATION OF BARGE SHIPMENTS,**  
Missouri Univ.-Rolla. School of Engineering.  
W. A. Brooks, H. E. Metzner, and M. L. Smith, Jr.  
Transportation Journal, Vol. 18, No. 1, p 36-44, 1978. 2 fig, 8 tab, 7 ref.

Descriptors: \*Barges, \*Costs, \*Optimization, \*Computer models, \*Dedicated towing service, \*General towing service, \*Cost analysis, Shipping, Transportation, Model studies, Inland waterways, Linhaul costs, Terminal costs, Ownership costs.

A computer model minimizes barge costs incurred by shippers on the inland waterway system, including linhaul costs, terminal costs at origin and destination, cargo insurance, and inventory expenses. Linhaul costs are calculated in a unique way for both dedicated and general towing service. The model comprises four basic calculations: (1) transit/terminal and interchange times, (2) costs for each towing service, (3) barge ownership costs, and (4) miscellaneous shipping costs. Calculations for each type of towing service are repeated for each cost analysis. An illustration of the use of the model is exemplified with two movements of liquid styrene from Houston, Texas, to Cincinnati, Ohio; the amount of tonnage is varied while holding constant other cost factors, including barge type and capacity, terminal times, and reshipping at the destination. Conclusions: (1) at higher volume, dedicated towing service generally offers reduced barge ownership and towing costs on a distributed basis (per net ton), plus faster and more uniform round trip times; (2) at lower volume, general towing service should be used; and (3) a total barge-incurred cost curve should be constructed for varying amounts of tonnage in the general range of anticipated tonnage. The mode may also be applied to trucking and railway shipping. (Lynch-Wisconsin)  
W79-05317

**6D. Water Demand**

**DETECTION OF ENTEROVIRUSES AND BACTERIAL PATHOGENS SURVIVING STANDARD SEWAGE TREATMENT,**  
Maryland Univ., College Park. Dept. of Microbiology.

For primary bibliographic entry see Field 5B.  
W79-05090

**PRELIMINARY APPLICATIONS OF LANDSAT IMAGES AND AERIAL PHOTOGRAPHY FOR DETERMINING LAND-USE, GEOLOGIC AND HYDROLOGIC CHARACTERISTICS—YAMPA RIVER BASIN, COLORADO AND WYOMING,**  
Geological Survey, Lakewood, CO. Water Resources Div.; and Geological Survey, Sioux Falls, SD. Water Resources Div.  
For primary bibliographic entry see Field 7B.  
W79-05163

**A WATER DEMAND AND WASTEWATER DISPOSAL MODEL FOR OPTIMUM TRANSFER OF WATER RESOURCES TECHNOLOGY IN DEVELOPING COUNTRIES,**  
Federal Univ. of Parabi, Campina Grande (Brazil). Dept. of Civil Engineering.  
M. I. Muiga, and G. W. Reid.  
In: Water Knowledge Transfer, Volume 2, Proceedings of the Second International Conference on Transfer of Water Resources Knowledge, June 1977, Fort Collins Colorado. N.S. Grigg, et al., Ed., Water Resources Publications, Fort Collins, Col., 1978, p 1000-1016. 3 fig, 7 tab, 20 ref.

Descriptors: \*Water demand, \*Waste water disposal, \*Forecasting, \*Data analysis, \*Stepwise multi-

ple regression, Water resources, \*Developing countries, Municipal water, Costs, Statistical methods, Analytical techniques, Sewage, Estimating, Equations, Mathematical models, Systems analysis, Socio-economic conditions, Technology indicator, Optimum transfer.

This paper provides engineers, planners, and appropriate public officials in developing countries with innovative techniques for more effective methods of predicting municipal water demands and wastewater disposal in these countries. The forecasting equations developed can be used to project municipal water demand and wastewater discharged with a reasonable degree of reliability, rather than directly applying data from industrial nations to developing countries. Used are mathematical modeling techniques to derive predictive equations for municipal water demand and wastewater disposal models utilizing socio-economic, environmental, and technological indicators. Predictive equations are developed for each of the three regions of Africa, Asia, and Latin America. Data analysis indicates municipal water demand is a function of population, income, and a technology indicator (percentage of households connected to the water supply systems or having piped water). Shown is a weak association of demand to the price of water to the consumers. In the analysis, the amount of waste water increases daily with the increase of per capita consumption of water and with the increase of the wastewater disposal system, while in-house waste disposal processes show a decrease in per capita wastewater disposed daily. (See also W79-05409) (Bell-Cornell)  
W79-05413

**SURVEY ON SESAYAP RIVER AS POSSIBLE WATER RESOURCE FOR A PULP AND PAPER MILL (IN INDONESIA) (SURVEY SUNGAI SESAYAP DAN KEMUNGKINANNYA SEBAGAI SUMBER AIR UNTRK PABRIK PULP DAN KERTAS),**  
Berita Selulosa, Vol. 14, No. 1, p. 1-7, March, 1978. 2 illus, 3 ref, 3 tab. English summary.

Descriptors: \*Pulp and paper industry, \*Water supply, \*Indonesia, Water, Sites, Saline water, Water resources, Sesayap River (Indonesia), Indonesia.

Based on water samples taken over two months along the Sesayap River, various possible sites for a new pulp and paper mill in East Kalimantan Province are discussed, along with some water supply problems, such as salt water boundaries. (Brown-IPC)  
W79-05427

**ABSOLUTE SOLUTION TO INDUSTRIAL WASTE WATER PROBLEM—OUTFALL PREVENTION (DIE ABSOLUTE LOESUNG DES INDUSTRIEABWASSER-PROBLEMS — UNTERBINDUNG DES ABFLUSSES),**  
For primary bibliographic entry see Field 3E.  
W79-05433

**6E. Water Law and Institutions**

**INSTITUTIONAL ARRANGEMENTS FOR EFFECTIVE WATER MANAGEMENT IN COLORADO,**  
Colorado State University, Fort Collins, CO. Dept. of Political Science.  
P. O. Foss.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 647, Price codes: A11 in paper copy, A01 in microfiche. Water Resources Research Institute. Colorado State University, Completion Report, November, 1978. 232 p, 121 ref. OWRT A-029-COLO(2). 14-34-001-6006.

Descriptors: \*Water supply, \*Institutions, \*Political aspects, \*Legal aspects, Governments, Competing uses, Legislation, Planning, Intergovernmental relations, Colorado, Rocky Mountain States.



## Field 6—WATER RESOURCES PLANNING

### Group 6E—Water Law and Institutions

Rapidly increasing population and industrial growth in Colorado have sharply increased demands for water. In the face of these increasing demands, water supply is relatively fixed. Present occasional or isolated shortages will soon become chronic. The study attempts to develop politically acceptable institutional arrangements for increasing the supply and for more efficient methods of utilizing present supplies. Among the options for increasing supply are: reevaluation of Colorado's commitments to downstream states; construction of additional storage developments with state funds or consortiums of sub-state units; increased state support for precipitation augmentation; increased state support for watershed management; increased ground water withdrawals; and an expeditious resolution of Federal Reserved Rights and Indian claims. Options for increasing efficiency of present supply by institutional methods include: discourage population growth; integrate land and water planning; employ the zoning concept to regulate water use; integrate water quantity and water quality management in the same agency; encourage ground and surface water management; encourage conservation methods in irrigation and municipal use; facilitate temporary transfers including a state 'water bank'; integrate management of all water supply units in a single state water board. W79-05049

**THE GERMAN FEDERAL LAW ON WASTEWATER CHARGES,**  
Technische Univ., Darmstadt (Germany, F.R.).  
G. Rinck.  
Progress in Water Technology, Vol. 10, No. 3-4, p 95-102, 1978. 3 fig, 20 ref.

Descriptors: \*Pollution taxes (Charges), \*Economics, \*West Germany, \*Water pollution control, \*Regulation, \*Legal aspects, \*Legislation, Water quality standards, Effluent limitations, Effluents, Waste water disposal, Political constraints, Permits, Economic efficiency, Damages, Marginal costs, River basin commissions, Incentives, Motivation.

Potential effects of West Germany's 1976 water pollution control law which incorporates effluent charges are analyzed. Extended political debate resulted in several compromises in the law and effluent charges consequently form only part of a combined system of incentives along with regulations and regional planning. Various pollution control methods are reviewed, including effluent standards or regulations; moral and political pressure; liability for damages; fines; subsidies, loans, or tax remissions; river basin associations; and economic incentives through effluent charges and marketable effluent permits. The law provides for assessment of charges to begin in 1981 instead of 1976 as in an earlier draft, and to reach the full rate of 40 DM (capital and operation costs)/SE (damage equivalents) by 1986. The 'polluter pays' principle was not realized, and some exceptions decrease the effect of efficiency standards. Pollution damage equivalents (SE) are determined on the basis of several parameters: (1) suspended solids with an organic portion 10% or greater (1 SE/cu m/a); (2) suspended solids with an organic portion less than 10% (0.1 SE/cu m/a); (3) organic matter in the settled sample (2.2 SE/100 kg COD/a); (0.3 SE.G sub F/1000 cu m/a). G sub F is the point of dilution at which wastewater is no longer toxic to the fish *Leuciscus melanotus*. (Lynch-Wisconsin)  
W79-05315

**KENNEBEC RIVER CORRIDOR PLAN - A MANAGEMENT PLAN FOR A REJUVENATED RESOURCE,**  
North Kennebec Regional Planning Commission, Winslow, ME.  
For primary bibliographic entry see Field 6B.  
W79-05402

**KENNEBEC RIVER CORRIDOR PROJECT - APPENDIX I: DEMOGRAPHY,**  
North Kennebec Regional Planning Commission, Winslow, ME.

For primary bibliographic entry see Field 6B.  
W79-05403

**KENNEBEC RIVER CORRIDOR PROJECT - APPENDIX II: WATER RESOURCES,**  
North Kennebec Regional Planning Commission, Winslow, ME.  
For primary bibliographic entry see Field 6B.  
W79-05404

**KENNEBEC RIVER CORRIDOR PROJECT - APPENDIX V: MANAGEMENT PLAN,**  
North Kennebec Regional Planning Commission, Winslow, ME.  
For primary bibliographic entry see Field 6B.  
W79-05407

**CONNECTICUT RIVER DIVERSION: A CASE STUDY IN WATER ALLOCATION POLICY,**  
Massachusetts Univ., Amherst. Water Resources Research Center.  
For primary bibliographic entry see Field 6B.  
W79-05414

**THE LAW OF SURFACE WATER ALLOCATION IN GEORGIA,**  
Georgia Univ., Athens. Inst. of Natural Resources.  
J. O. Smith.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 634.  
Price codes: A05 in paper copy, A01 in microfiche.  
Environmental Resources Center, Georgia Institute of Technology, Atlanta. Report No. ERC 05-78, September 1978, 82 p., OWRT A-072-GA(1), 14-34-0001-7022.

Descriptors: Riparian rights, Diversion, \*Water rights, Inter-basin transfer, \*Water allocation, Reservoirs.

Predicted water supply shortages and other water problems in the Atlanta metropolitan area gave impetus recently to studies undertaken at the direction of federal and state congressional resolutions. All of the proposed alternative solutions raise one or several common legal issues. In 1977, the Georgia General Assembly enacted amendments to the Water Quality Control Act to allow the Environmental Protection Division to control some uses of surface waters through a permit program. The provisions of the amendments in most instances carefully avoid clearly unconstitutional divestments of water rights. However, in the areas of transbasin diversion of water and use of water on non-riparian lands, the amending statute creates as many uncertainties as it was intended to resolve. Federal reservoirs are a significant potential source of high-quality water supplies. Federal authority exists to support allocation of some of these waters by reservoir managers without prior congressional authorization. However, major water allocations from such federal impoundments will require reauthorization by Congress. In either case, such allocations by federal authority will have to be consistent with state law.  
W79-05415

### 6F. Nonstructural Alternatives

**PLAN OF STUDY: CASE STUDIES OF THE APPLICATION OF COST SHARING POLICY OPTIONS FOR FLOOD PLAIN MANAGEMENT IN THE CONNECTICUT RIVER BASIN,**  
New England River Basins Commission, Hanover, NH.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 386.  
Price codes: A07 in paper copy, A01 in microfiche.  
September 8, 1977. 118 p. OWRT IA-TQ-3.

Descriptors: \*Flood control, \*Non-structural alternatives, \*Cost sharing, Water Resources Development Act, Flood plain management, Water resources planning, Connecticut River, Institutions, Flood proofing.

This document describes a Plan of Study for the conduct of special flood plain management and institutional studies to be carried out by the New England River Basins Commission, pursuant to Section 73(b) of the Water Resources Development Act of 1974, P.L. 93-251. This act authorizes federal cost sharing of 80 percent or more for nonstructural flood plain management measures such as relocation, flood proofing, flood plain regulation and open land acquisition. Its implementation has been held up to permit the Water Resources Council and its member agencies to examine its financial and institutional implications and, on the basis of this examination, to propose policies, procedures, terms and conditions under which federal funding will be authorized under the act. The 'Section 73' study will consider and make recommendations to the Council and basin states on how to secure implementation of federal cost sharing for nonstructural flood plain management studies under Section 73; and to assist the agencies in the formulation, evaluation and selection of cost sharing alignments and institutional arrangements needed to implement flood plain management programs.  
W79-05232

**FLOOD-PLAIN MANAGEMENT IN DALLAS, TEX.: 1906-1978,**  
Dallas Dept. of Public Works, TX.  
M. McCorkle, and A. H. Half.  
Journal of the Hydraulics Division, Vol. 105, No. HY2, p. 125-137, February 1979. Proceedings of the American Society of Civil Engineers. 1 fig, 3 tab, 7 ref.

Descriptors: \*Flood control, \*Land reclamation, \*Municipal engineering, \*Floodways, \*Flood plains, Regulation, Hydraulics, Hydrology, Land use, Storm sewers, Water management (Applied), Nonstructural alternatives, Structural approaches.

Dallas, Texas has faced serious flooding problems due to rapid urbanization and encroachment upon flood plains. The city's flood-plain management has relied on both nonstructural and structural approaches to flood-loss prevention. The overall program emphasizes: (1) careful delineation; (2) an individualized response to each drainage basin; (3) multipurpose use of reclaimed and preserved flood plains; (4) public ownership of land reserved for flood-water conveyance; and (5) flood-plain management that maximizes visual environmental qualities. (Bell-Graf-Cornell)  
W79-05272

### 6G. Ecologic Impact Of Water Development

**COASTAL MORPHOLOGY, OIL SPILL VULNERABILITY AND SEDIMENTOLOGY OF KOTZEBUE SOUND AND KODIAK ISLAND,**  
South Carolina Univ., Columbia. Dept. of Geology.

For primary bibliographic entry see Field 5C.  
W79-05213

**THE EFFECTS OF OIL ON TEMPERATURE REGULATION IN SEA OTTERS,**  
Scripps Institution of Oceanography, La Jolla, CA. Physiological Research Lab.  
For primary bibliographic entry see Field 5C.  
W79-05214

**SUBLETHAL EFFECTS OF PETROLEUM HYDROCARBONS AND TRACE METALS, INCLUDING BIOTRANSFORMATIONS, AS REFLECTED BY MORPHOLOGICAL, CHEMICAL, PHYSIOLOGICAL, PATHOLOGICAL AND BEHAVIORAL INDICES,**  
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.  
For primary bibliographic entry see Field 5C.  
W79-05216

## 7B. Data Acquisition

**THE WORLD REMOTE SENSING INDEX, A COMPREHENSIVE GEOGRAPHIC INDEX BIBLIOGRAPHY TO REMOTE SENSING SITE INVESTIGATIONS OF NATURAL AND AGRICULTURAL RESOURCES THROUGHOUT THE WORLD.**

December 1976. 631 p. P. F. Krumpel, Compiler. Tensor Industries, Inc., Fairfax, Virginia.

Descriptors: \*Bibliographies, \*Remote sensing, \*Geographical regions, Natural resources, Land resources, Agriculture, On-site investigations, Indexing, Documentation, Resources, Abstracts, Publications, Forestry, Environment, Soils, Hydrology, Water management (Applied), Oceanography, Mapping, Geographic index, Marine ecology.

This volume is a geographic index bibliography of over 4,000 references on remote sensing of natural and agricultural resources throughout the world. Citations from 1970 to August 1976 were arranged within 14 major disciplines among more than 150 geographic areas, states, and countries. This extensive compilation originated from more than 850 foreign and domestic sources among six major publishing categories. Instructions for procuring desired publications or reports were included in addition to guidelines for efficient utilization of the document. This book was designed as an integrated reference guide for use in remote sensing and environmental education, training, applications research, analysis, and technology transfer. (Froehlich-ISWS) W79-05119

**PREDICTION OF SOIL LOSS ON CROPLAND WITH REMOTE SENSING.**

Texas Christian Univ., Fort Worth. Dept. of Geology. K. M. Morgan, G. B. Lee, R. W. Kiefer, T. C. Daniel, and G. D. Bubenzer. Journal of Soil and Water Conservation, Vol. 13, No. 6, p 291-293, November-December 1978. 1 fig, 2 tab, 24 ref.

Descriptors: \*Remote sensing, \*Soil erosion, \*Land use, \*Wisconsin, Crops, Aerial photography, Watersheds (Basins), Agricultural watersheds, Erosion, Sediments, Erosion control, Water quality, Data processing, Agriculture, Universal soil loss equation, Soil loss.

High-altitude color and color infrared photography were used in conjunction with the universal soil loss equation to predict inter-rill and rill erosion on cropland in three Dane County, Wisconsin, watersheds with varying soils, topography, and land use. Soil loss predictions based on remote-sensing interpretations agreed closely with predictions based on field studies. (Sims-ISWS) W79-05148

**PRELIMINARY APPLICATIONS OF LANDSAT IMAGES AND AERIAL PHOTOGRAPHY FOR DETERMINING LAND-USE, GEOLOGIC AND HYDROLOGIC CHARACTERISTICS—YAMPA RIVER BASIN, COLORADO AND WYOMING.**

Geological Survey, Lakewood, CO. Water Resources Div.; and Geological Survey, Sioux Falls, SD. Water Resources Div. F. J. Heimes, G. K. Moore, and T. D. Steele. Geological Survey Water-Resources Investigations 78-96 (open-file report), October 1978. 48 p, 19 fig, 7 tab, 18 ref.

Descriptors: \*Land use, \*Aerial photography, \*Satellites (Artificial), \*Remote sensing, \*River basin development, Water demand, Land classification, On-site investigations, Regional analysis, Arid lands, Colorado, Wyoming, \*Yampa River basin, \*Upper Colorado River basin, \*LANDSAT.

Expanded energy- and recreation-related activities in the Yampa River basin, Colorado and Wyoming, have caused a rapid increase in economic

**MITIGATING ADVERSE ENVIRONMENTAL EFFECTS OF HIGHWAY CONSTRUCTION.**

Available from the National Technical Information Service, Springfield, VA 22161 as PB-247 737, Price codes: A03 in paper copy, A01 in microfiche. Transportation Research Record 551, 1975. 42 p. Transportation Research Board, National Research Council, National Academy of Sciences, Washington, DC. Wilburn, M.C., editor.

Descriptors: \*Highways, \*Environmental effects, \*Erosion, \*On-site investigations, Road construction, Landscaping, Highway beautification, Grasses, Pollutants, Silts, Lakes, Recreation, Sedimentation, Erosion control, Construction, Vegetation, Land use, Social aspects, Social impact, Vegetation establishment, Cities, Rural areas, Institutions, Organizations.

The 4 papers in this report indicated the wide range of disciplines and interests that are involved in the roadside environmental aspects of highway construction. The subject areas covered and related to water resources included interdisciplinary team approach to mitigating adverse environmental impacts of highway construction, silt barriers as erosion pollution control in a large recreational lake, and better grasses for roadsides. (See also W79-05236 thru W79-05238) (Humphreys-ISWS) W79-05235

**INTERDISCIPLINARY TEAM APPROACH TO MITIGATING ADVERSE ENVIRONMENTAL IMPACTS OF HIGHWAY CONSTRUCTION.**

Federal Highway Administration, Sacramento, CA. California Div. J. R. Gordon.

In: Mitigating Adverse Environmental Effects of Highway Construction; Transportation Research Record 551, p 1-11, 1975. 8 fig, 1 tab.

Descriptors: \*Highways, \*Environmental effects, \*California, \*Planning, \*Organizations, Institutions, Management, On-site investigations, Wildlife habitats, Vegetation, Dunes, Marshes, Ponds, Mitigation, Interdisciplinary team.

To assess the effectiveness of the interdisciplinary team approach in highway planning and project development in California, the author, by using the case study method, examined the interrelationships and interworkings of engineering and nonengineering skills in addressing problems associated with the impact of highway construction on the sensitive natural environment within the jurisdiction of the Coastal Zone Conservation Commission. As a result of this analysis, it was concluded that agency organizations should provide for an in-house core of expertise and use outside consultants only when highly specialized expertise is needed. Also, the organization must be flexible so that the concept can be applied easily at all stages of the highway planning and project development process. Of importance to the successful operation of the interdisciplinary team approach is the attitude of top management. It must be responsive to issues raised by all disciplines and must consider the contributions of all disciplines equally and fairly. Through the implementation of the California Action Plan, California has committed itself to the effective application of the interdisciplinary team approach. (See also W79-05235) (Humphreys-ISWS) W79-05236

**BETTER GRASSES FOR ROADSIDES.**

Rutgers - The State Univ., New Brunswick, NJ. Dept. of Soils and Crops. R. W. Duell, and R. M. Schmit.

In: Mitigating Adverse Environmental Effect of Highway Construction; Transportation Research Record 551, p 30-41, 1975. 8 fig, 13 tab, 4 ref.

Descriptors: \*Highways, \*Vegetation establishment, \*Grasses, \*New Jersey, Environmental effects, Landscaping, Bank protection, Slope protection, Roadbanks, Highway beautification, On-site tests, Land use, Bluegrasses, Fescues.

The growing importance of maintenance costs and environmental aesthetics dictates the need to de-

velop better roadside grasses. More than a thousand varieties or strains of 36 species were established in 4 sq yd plots along 8 roadsides throughout New Jersey and 3 experiment station sites over 5 years. Coarse grasses, including Kentucky 31 tall fescue and redbud, consistently produced conspicuous, persistent seed heads that detract from the appearance of the grassy landscape. Finer turf grasses, including certain varieties of Kentucky bluegrasses and 4 fine fescues, established readily and produced fewer and less objectionable seed stalks. Perennial ryegrass varieties initially produced an abundance of foliage and seed stalks, excessively crowded associated grasses, and disappeared after 2 years of low-intensity management. Outstanding performance of spreading fine fescues at several locations prompted the development of a new variety, Fortress, synthesized from locally collected elite plants. The importance of seed-free mulch was shown. It appears inappropriate to try to keep down vigorous species with frequent mowing or to tolerate their coarse appearance when unmowed. Better appearance with less mowing can be achieved with properly established mixtures of superior varieties of fine fescues and Kentucky bluegrasses. (See also W79-05235) (Humphreys-ISWS) W79-05238

**ECOLOGICAL OBSERVATION ON THE ADULT SALMON: I. DIURNAL VARIATION OF UPSTREAM MIGRATION OF THE ADULT CHUM SALMON IN THE CHITOSE RIVER (IN JAPANESE).**

Hokkaido Salmon Hatchery, Sapporo (Japan). H. Mayama, and T. Takahashi. Sci Rep Hokkaido Salmon Hatchery 31, p 21-18, 1977. (English summary).

Descriptors: \*Salmon, \*Fish migration, \*Power-lanes, Japan, Streamflow.

Diurnal variation of upstream migration of the adult chum salmon (*Oncorhynchus keta*) was observed at the Nishikoshi (Japan) catching station of the Chitose River, a tributary of the Ishikari River, during Oct. in 1974 and in 1975. Upstream activity occurred principally in daytime. A major factor controlling upstream movement was the fluctuation in the amount of water discharged from power plants located on the upper river. Copyright 1978, Biological Abstracts, Inc. W79-05348

## 7. RESOURCES DATA

## 7A. Network Design

**EVALUATION AND DESIGN OF A STREAMFLOW-DATA NETWORK IN WASHINGTON.**

Geological Survey, Reston, VA. Water Resources Div., and Geological Survey, Tacoma, WA. Water Resources Div. M. E. Moss, and W. L. Haushild.

Geological Survey open-file report 78-167, 1978. 43 p, 7 fig, 1 plate, 7 tab, 15 ref.

Descriptors: \*Streamflow, \*Network design, \*Washington, \*Model studies, \*Regional analysis, Regression analysis, Average flow, Floods, Peak discharge, Flood forecasting, Flood frequency.

A network-design technique developed by Moss and Karlinger (1974) is described and applied in the evaluation and design of a streamflow-data network in Washington State. The technique evaluates the changes in the accuracy of regionalization models that result from changes in lengths of periods of record, or number of stations. The regionalization models for natural-flow streams in Washington are the regression equations for means and standard deviations of the annual mean-flow and peak-flow series and floods with exceedance probabilities of 2 percent. The net work-design analyses indicate that relatively little improvement in the accuracy of estimation at streamflow data-neither in terms of added record length nor added streamflow stations. (Woodard-USGS) W79-05159



## Group 7B—Data Acquisition

development which will result in increased demand and competition for natural resources. In planning for efficient allocation of the basin's natural resources, Landsat images and small-scale color and color-infrared photographs were used for selected geologic, hydrologic and land-use applications within the Yampa River basin. Applications of Landsat data included: (1) regional land-use classification and mapping, (2) lineament mapping, and (3) areal snow-cover mapping. Results from the Landsat investigations indicated that: (1) Land-use land-use classification maps, at a regional level, compared favorably with areal land-use patterns that were defined from available ground information, (2) lineaments were mapped in sufficient detail using recently developed techniques for interpreting aerial photographs, (3) snow cover generally could be mapped for large areas with the exception of some densely forested areas of the basin and areas having a large percentage of winter-season cloud cover. Aerial photographs were used for estimation of turbidity for eight stream locations in the basin. Spectral reflectance values obtained by digitizing photographs were compared with measured turbidity values. Results showed strong correlations (variances explained of greater than 90 percent) between spectral reflectance obtained from color photographs and measured turbidity values. (Woodard-USGS) W79-05163

**ACOUSTIC MONITORING OF INDUSTRIAL CHEMICAL WASTE RELEASE AT DEEP WATER DUMP SITE 106,**  
Woods Hole Oceanographic Institution, MA.  
Dept. of Ocean Engineering.  
For primary bibliographic entry see Field 5B.  
W79-05264

**CONTROL OF OIL POLLUTION BY REMOTE SENSING ALONG THE SHORES OF FRANCE,**  
French Embassy, Washington, DC.  
J-C. Mourlon.  
In: Proceedings of the Twelfth Symposium on Remote Sensing of Environment, held in Manila, Philippines, 20-26 April 1978. Environmental Research Institute of Michigan, Ann Arbor, 1978. Vol. 1, p. 235-238.

Descriptors: \*Oil spills, \*Oil pollution, \*Remote sensing, \*Pollutant identification, Water pollution control, Path of pollutants, \*Outer Continental Shelf, \*France, Infrared radiometry, Airborne equipment.

Several countries, including France, have developed remote sensors that can be used aboard surveillance aircraft to detect and identify pollutants. After several years of basic research, experimentation, and technological optimization, remote sensing by infrared radiometry using equipment developed by the 'Societe Anonyme de Telecommunications' (SAT) for the collection and transmission of data, was chosen as a means of controlling oil discharges and spills at sea. This report describes the organization of surveillance campaigns and the aerial, airborne and ground equipment used. During the first two campaigns a number of significant oil discharges were recorded, nine of which were judged sufficiently large to be further investigated. It is felt that if these campaigns are repeated regularly, they should have a dissuasive effect. (Sinha-OEIS) W79-05392

**REMOTE SENSING FOR OIL POLLUTION CONTROL ALONG COASTAL WATERS OF THE UNITED STATES,**  
Coast Guard Research and Development Center, Groton, CT.  
J. White, and L. R. Breslau.  
In: Proceedings of the Twelfth International Symposium on Remote Sensing of Environment, held in Manila, Philippines, 20-26 April 1978. Environmental Research Institute of Michigan, Ann Arbor, 1978. Vol. 1, p. 239-255, 10 fig, 8 ref.

Descriptors: \*Oil pollution, \*Water pollution control, \*Monitoring, \*Remote sensing, Aircraft, Oil

spills, Pollution abatement, United States, \*Outer Continental Shelf, Airborne sensors, U.S. Coast Guard.

The Coast Guard has specific responsibilities for responding to and coordinating activities associated with pollutant spills that occur in the coastal area including ports, harbors and other waters on which ocean going vessels operate as well as adjacent high seas areas. The Coast Guard has successfully developed an operational airborne surveillance system and is currently conducting routine surveillance patrols with the system called 'Airborne Oil Surveillance System-II' (AOSS-II) which evolved from predecessor systems called the 'Airborne Remote Sensing System' (ARRS) and the 'Airborne Oil Surveillance System-I' (AOSS-I). The currently operational AOSS-II system is destined to be superseded by a system currently under development called the 'Airborne Remote Instrumentation System' (AIREYE). All of these systems are described. (Sinha - OEIS) W79-05393

**REMOTE SENSING OF THE OCEANS - A REVIEW,**  
Aircraft Research and Development Unit, Edinburgh (Australia).  
G. A. Morgan.

In: Proceedings of the Twelfth International Symposium on Remote Sensing of Environment, held in Manila, Philippines, 20-26 April 1978. Environmental Research Institute of Michigan, Ann Arbor, 1978. Vol. 1, p. 399-617, 7 fig, 6 tab, 66 ref.

Descriptors: \*Remote sensing, \*Monitoring, \*Pollution abatement, Water pollution control, Oil pollution, Satellites(Artificial), Outer Continental Shelf, SEASAT-A.

With the imminent launching of SEASAT-A an historical perspective of events leading up to this pioneering perspective is given and the evolution of current spacecraft having ocean sensing capabilities is outlined. Applications of remote sensing of the oceans from space are described including some in the Australian region. The continuing role of man in space as an observer of the oceans is illustrated by a discussion of likely future developments in the SHUTTLE/SPACELAB era. (Sinha-OEIS) W79-05394

**IMAGE ENHANCEMENT OF SIDE-SCAN SONAR MAPPING,**  
California Univ., Santa Barbara.

B. P. Luyendyk, E. J. Hajic, and D. S. Simonett.  
In: Proceedings of the Twelfth International Symposium on Remote Sensing of Environment, held in Manila, Philippines, 20-26 April 1978. Environmental Research Institute of Michigan, Ann Arbor, 1978. Vol. 2, p. 1025-1026.

Descriptors: \*Remote sensing, \*Mapping, \*Hazards, \*Water pollution control, Resources development, Oil and gas, Geology, California, Outer Continental Shelf, Side-scan sonar.

The Santa Barbara Channel is typical of many border lands in that information on environmental geology is needed to provide citizens, industry and government with a realistic and accurate estimate of the geologic hazards affecting present and future resource development in coastal areas (oil and gas, fisheries, mining). For example, at the present time many offshore oil installations, including the world's deepest water platform (in construction), are located in the fault-laced Santa Barbara Channel. Existing geophysical information such as seismic reflection profiles, provide data mostly on older faults in deeper sub-bottom layers of the Channel. Side-scan sonar surveys will provide unique information on the character and stability of the sea bed itself. Side-scan sonar mapping allows a broad swath of seafloor textural information to be obtained in a short period of time and fault scarps, cracks, outcrops, sand waves, dunes, and ripples can be recognized. (Sinha-OEIS) W79-05395

**THE USE OF LANDSAT IMAGERY FOR MARINE POLLUTION STUDIES,**  
Singapore Univ.

Y. J. Chong.

In: Proceedings of the Twelfth International Symposium on Remote Sensing of Environment, held in Manila, Philippines, 20-26 April 1978. Environmental Research Institute of Michigan, Ann Arbor, 1978. Vol. 3, p. 1741-1742.

Descriptors: \*Remote sensing, \*Resources development, \*Monitoring, \*Water pollution control, Environmental effects, Baseline studies, Coasts, \*Outer Continental Shelf, Landsat imagery, Southeast Asia, Environmental impact.

A Landsat scene of the southernmost tip of the Asian mainland covers not only a very busy international waterway, the Straits of Singapore/Malacca, connecting the Pacific Ocean with the Indian Ocean, but also land areas of three countries where intense developments are being carried out. Remote sensing can play a useful role in supplementing the numerous ground level environmental studies. This presentation concerns the use of Landsat data to obtain a precision image data base upon which overlays may be made to study the changes taking place; and provide a synoptic view of the region indicating how developments in one area can possibly influence marine pollution in the coastal zones of another area. (Sinha-OEIS) W79-05396

## 7C. Evaluation, Processing and Publication

**THE SEYMOUR AQUIFER GROUND-WATER QUALITY AND AVAILABILITY IN HASKELL AND KNOX COUNTIES, TEXAS, VOLUME I.**  
Texas Dept. of Water Resources, Austin.  
For primary bibliographic entry see Field 2F.  
W79-05014

**THE SEYMOUR AQUIFER GROUND-WATER QUALITY AND AVAILABILITY IN HASKELL AND KNOX COUNTIES, TEXAS, VOLUME II.**  
Texas Dept. of Water Resources, Austin.  
Report 226, December 1978. 265 p, 16 fig, 23 tab.

Descriptors: \*Data collections, \*Groundwater resources, \*Texas, \*Aquifers, \*Water quality, \*Chemical analysis, Well data, Water wells, Drillers logs, Groundwater availability, Brine disposal, Water pollution sources, Water levels, Hardness(Water), Dissolved solids, Sieve analysis, Particle size, Sulfates, Chlorides, Nitrates, Oil wells, \*Haskell County(TX), \*Knox County(TX), \*Seymour aquifer.

This report was prepared in two volumes. Volume I described the quality and availability of the groundwater resources of the Seymour aquifer. It contained text and related illustrations and tables. Volume II contained supporting basic data consisting of maps and tables including: 15 well location maps; records of 2,058 water wells; records of water levels in 93 wells; results of chemical analyses of 2,197 water samples plus 11 tables containing results of over 200 additional chemical analyses on various specialized samples; 240 drillers' logs; descriptions of geologic samples from 16 surface localities and 4 wells; results of sieve analyses of formation samples; a cross-index of previously published well numbers; a list of available aerial photographs; and information on the production and disposal of oil field brines. (See also W79-05014) (Humphreys-ISWS) W79-05015

**FLUVIAL PROCESSES AND FACIES SEQUENCES IN THE SANDY BRAIDED SOUTH SASKATCHEWAN RIVER, CANADA,**  
McMaster Univ., Hamilton (Ontario). Dept. of Geology.  
For primary bibliographic entry see Field 2J.  
W79-05135

## Structures—Group 8A

**ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1977 TO SPRING 1978**

Geological Survey, Tucson, AZ. Water Resources Div.

For primary bibliographic entry see Field 4B.  
W79-05151

**SUMMARY APPRAISALS OF THE NATION'S GROUND-WATER RESOURCES—MISSOURI BASIN REGION**

Geological Survey, Lakewood, CO. Water Resources Div.  
O. J. Taylor.

Available from Supt. of Documents, GPO, Washington, DC 20402. Price, \$3.00. Geological Survey Professional paper 813-Q, 1978. 41 p, 12 fig, 3 plates, 8 tab, 53 ref.

Descriptors: \*Groundwater resources, \*Regional analysis, \*Missouri River, \*Water supply, \*Aquifer characteristics, Water quality, Withdrawal, Water yield, Hydrology, Groundwater recharge, Water utilization, Water reuse, Aquifer management, Surface-groundwater relationships, Groundwater availability, \*Missouri Basin Region, Summary appraisals.

The Missouri Basin Region, about one-sixth of the contiguous United States, utilizes large water supplies for irrigation, industrial, public supply, and rural use. Groundwater resources occur in sand and gravel alluvium, glacial deposits, dune sand, basinfill deposits of sand and gravel, sandstone, siltstone, fractured sandy clay, limestone, and dolomite. Ground water is undeveloped in many areas. Unconsolidated and semiconsolidated aquifers have potential for conjunctive use with surface water, reuse of available supplies, artificial recharge, and salvage of evapotranspiration. Sandstone aquifers have potential for artificial recharge, induced interaquifer leakage, conjunctive use with surface water, and temporary mining of ground water. Limestone and dolomite aquifer have potential for development of a large water supply, induced increase in recharge, and induced interaquifer leakage. Saline ground water occurs throughout the region, but is most abundant in deep aquifers in Wyoming, North Dakota, and South Dakota. Improved water use in the Missouri Basin Region would require a periodic inventory of current supplies in precipitation, streamflow, surface-water storage, and ground water; an awareness of the many possible alternatives to meet demands; and implementation of sound water-management plans. (Woodard-USGS)  
W79-05152

**NEBRASKA WATER DATA PROGRAMS, 1978**

Geological Survey, Lincoln, NE. Water Resources Div.

Geological Survey open-file report 78-823, 1978. 131 p, 2 fig, 1 tab, 57 ref, append.

Descriptors: \*Nebraska, \*Water resources development, \*Programs, \*Data collections, \*Water quality, Surface waters, Groundwater, Aquifers, Water yield, Streamflow, Gaging stations, Sediment transport, Water analysis, Chemical analysis, Projects, Publications, Bibliographies, \*State agencies, \*U.S. Geological Survey.

Projects of the Water Resources Division, U.S. Geological Survey, and of State agencies represented by members of the Nebraska Water Data Coordinating Committee are described. The committee members represent the Nebraska Department of Water Resources, Nebraska Department of Environmental Control, Nebraska Department of Health, Conservation and Survey Division of the University of Nebraska-Lincoln, Nebraska Water Resources Center of the University of Nebraska, Nebraska Natural Resources Commission, and Nebraska Game and Parks Commission. Current measuring sites are listed. Indexes to streamflow records and flood-prone area maps and a list of recently published reports also are included. Sources of water-related information are given with names, addresses, and telephone numbers. (Woodard-USGS)

W79-05160

**WATER RESOURCES DATA FOR MONTANA, WATER YEAR 1977**

Geological Survey, Helena, MT. Water Resources Div.

Geological Survey Water-Data Report MT-77-1, October 1978. 751 p, 10 fig, 5 tab.

Descriptors: \*Montana, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1977 water year for Montana consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 209 gaging stations, stage only records for 1 lake station, stage and contents for 9 lakes and reservoirs, water quality for 112 stations and 3 lakes, and water levels for 23 observation wells. Also included are 191 crest-stage partial-record stations and 52 smaller reservoirs. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Montana. (Woodard-USGS)  
W79-05162

**FLOOD AND RELATED DEBRIS FLOW HAZARDS MAP**

Geological Survey, Carson City, NV. Water Resources Div.

T. L. Katzer, and P. A. Glancy.  
Nevada Bureau of Mines and Geology Environmental Series Map, 1978. 1 sheet.

Descriptors: \*Maps, \*Floods, \*Flood plains, \*Debris avalanches, \*Sediment transport, \*Particle size, Boulders, Fine aggregates, California, Nevada, \*South Lake Tahoe quadrangle, \*Truckee River basin, \*Flood-debris hazard zone.

Estimates of the 100-year floodflow were made and the corresponding flood plains were outlined on the map (scale 1:24,000) for the principal streams in the South Lake Tahoe quadrangle, California-Nevada. Degrees of hazard were assigned to the flood plains of these streams on the basis of floodflows and potential debris movement and are depicted on the map. (Woodard-USGS)  
W79-05165

**THE UNITED STATES GEOLOGICAL SURVEY IN ALASKA: ACCOMPLISHMENTS DURING 1977**

Geological Survey, Reston, VA. Water Resources Div.

Available Branch of Distribution, USGS 1200 S. Eads St. Arlington, VA 22202. Geological Survey Circular 772-B, 1978. 115 p, 48 fig, 5 tab.

Descriptors: \*Alaska, \*Projects, \*Water resources, \*Hydrology, \*Geology, Maps, Bibliographies, Environmental engineering, Engineering geology, Marine geology, Mineralogy, Economics, Data collections, Analytical techniques, \*U.S. Geological Survey, \*Annual report of accomplishments (1977).

United States Geological Survey projects in Alaska study a wide range of topics of economic and scientific interest. Work done in 1977 includes contributions to economic geology, regional geology, stratigraphy, engineering geology, hydrology, and marine geology. Many maps and reports covering various aspects of the geology and mineral and water resources of the State were published. In addition, the published 1:1,000,000-scale map of the State has been revised in two areas. A bibliography containing 263 reports on Alaska published in 1977 is included. (Woodard-USGS)

W79-05167

**DATA FILE: NEW BEDFORD HARBOR, MASSACHUSETTS**

Woods Hole Oceanographic Institution, MA.

For primary bibliographic entry see Field 2L.

W79-05249

**USERS MANUAL: DATA STORAGE AND RETRIEVAL SYSTEM FOR PILOT WASTEWATER TREATMENT RESEARCH**

Cincinnati Univ., OH. Southwestern Ohio Regional Computer Center.

G. A. Fish, and S. L. Forsythe.

EPA-600/2-78-036, Environmental Protection Technology Series, Municipal Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, OH, March 1978. 99 p, 11 fig.

Descriptors: \*Computer programs, \*Waste treatment, \*Automatic data processing, Pilot plant, Water reclamation, Mathematical models, Systems analysis, Advanced wastewater treatment, Evaluation, Pollutants, Effects, Waste water (Pollution).

The computer system described herein was designed as a data storage and retrieval system for the water reuse project at the Blue Plains Treatment Plant located in Washington, DC. The system was designed to be run on EPA's UNIVAC 1110 located at Research Triangle Park, North Carolina and thus would require modification to be transferable to other computer systems. The Municipal Environmental Research Laboratory, MERL, was responsible for the water reuse project which was undertaken for the purpose of evaluating Advanced Waste Treatment Systems which have the potential for reliably producing potable quality water from municipal wastewater. The pilot study was intended to evaluate the effectiveness of various processes in removing specific pollutants from wastewater. The six processes being evaluated at Blue Plains were Lime Clarification, Nitrification, Denitrification, Carbon Absorption, Filtration, and Chlorination. This 'User's Manual' describes the programs and files of the system, the use of terminals while utilizing the system, and what the user needs to do to operate the five functions of the system. (Bell-Graf-Cornell)  
W79-05281

**A CONCEPTUAL MODEL OF THE KNOWLEDGE TRANSFER PROCESS**

Colorado State Univ., Fort Collins. Dept. of Sociology.

For primary bibliographic entry see Field 10D.  
W79-05410

## 8. ENGINEERING WORKS

## 8A. Structures

**REVIEW OF DESIGN, CONSTRUCTION, AND OPERATION OF SOLDIER CREEK DAM PROJECT, UTAH**

Wahler (W. A.) and Associates, Palo Alto, CA. Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 681. Price codes: A06 in paper copy, A01 in microfiche. June 1977. 110 p, 8 fig, 6 tab, 44 ref, 1 append, 10 photo. Dept Int 14-01-0001-77-C-10.

Descriptors: \*Hydraulic structures, \*Dams, \*Design, \*Evaluation, \*Utah, Dam design, Grouting, Earth dams, Dam construction, Outlet works, Reservoir operation, Safety, Dam foundations, Grout curtains, Stability, Seepage, \*Soldier Creek Dam (UT), \*Central Utah Project, Zoned embankments, Dam safety.

This study was an independent review of critical engineering data and documentation supplied by the Bureau of Reclamation. No independent site or materials investigations or tests were made. The purpose of the review was to determine if there are any apparent risks of serious distress or failure in



## Field 8—ENGINEERING WORKS

### Group 8A—Structures

filling the reservoir or project operation. Recommendations were made of prudent actions that should be accomplished to provide additional verification of project safety. It was concluded from available data that there may be significant risk of serious distress and/or failure associated with filling the reservoir behind Soldier Creek Dam. The limited data indicated several possible deficiencies which could jeopardize the safety of the dam. Adequate performance instrumentation is lacking, and the foundation surface preparation does not conform to current state-of-the-art practices and may be inadequate. (Humphreys-ISWS)  
W79-05239

#### REVIEW OF DESIGN, CONSTRUCTION, AND OPERATION OF MOUNTAIN PARK DAM PROJECT, OKLAHOMA

Wahler (W. A.) and Associates, Palo Alto, CA. Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 679. Price codes: A07 in paper copy, A01 in microfiche. June 1977. 118 p, 10 fig, 6 tab, 84 ref, 1 append, 16 photo. Dept Int 14-01-0001-77-C-10.

Descriptors: \*Hydraulic structures, \*Dams, \*Design, \*Evaluation, \*Oklahoma, Hydraulic design, Dam design, Concrete dams, Outlet works, Arch dams, Dam construction, Dikes, Stability, Spillways, Reservoir operation, Dam foundations, Safety, \*Mountain Park Dam project(OK), Dam safety.

This study was an independent review of critical engineering data and documentation supplied by the Bureau of Reclamation. No independent site or materials investigations or tests were made. The purpose of this review was to determine if there are any apparent risks of serious distress or failure in filling the reservoir or project operation. Recommendations were made of prudent actions that should be accomplished to provide additional verification of project safety. It was concluded that the site exploration and testing for design were adequate; the design of the dam is appropriate; and the construction of the dam and dikes was in conformance to construction specifications. (Humphreys-ISWS)  
W79-05240

#### REVIEW OF DESIGN, CONSTRUCTION, AND OPERATION OF MT. ELBERT FOREBAY DAM AND RESERVOIR PROJECT, COLORADO

Wahler (W. A.) and Associates, Palo Alto, CA. Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 680. Price codes: A06 in paper copy, A01 in microfiche. June 1977. 96 p, 10 fig, 1 tab, 46 ref, 1 append, 12 photo. Dept Int 14-01-0001-77-C-10.

Descriptors: \*Hydraulic structures, \*Dams, \*Design, \*Evaluation, \*Colorado, Dam design, Hydraulic design, Stability, Earth dams, Dam construction, Forebays, Embankments, Outlet works, Dikes, Penstocks, Safety, Intakes, Dam foundations, Reservoir operation, \*Mt. Elbert Project(CO), \*Fryingpan-Arkansas Project, Dam safety, Dam stability, Zoned embankments, Imperious blankets.

This study was an independent review of critical engineering data and documentation supplied by the Bureau of Reclamation. No independent site or materials investigations or tests were made. The purpose of this review was to determine if there are any apparent risks of serious distress or failure in filling the reservoir or project operation. Recommendations were made as to suggested prudent actions that should be accomplished to provide additional verification of project safety. The study indicated that the filling of the Mt. Elbert Forebay Reservoir should be delayed until certain engineering studies, reservoir blanket repairs, penstock gate control system modifications, and installation of augmented performance surveillance instrumentation have been completed. The reservoir should not be filled above elevation 9,620 ft until the reliability of Power Plant Unit 1, for making emer-

gency reservoir releases, has been demonstrated. (Humphreys-ISWS)  
W79-05241

#### REVIEW OF DESIGN, CONSTRUCTION, AND OPERATION OF CRYSTAL DAM PROJECT, COLORADO

Wahler (W. A.) and Associates, Palo Alto, CA. Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 683. Price codes: A06 in paper copy, A01 in microfiche. May 1977. 104 p, 10 fig, 3 tab, 87 ref, 1 append, 16 photo. Dept Int 14-01-0001-77-C-10.

Descriptors: \*Hydraulic structures, \*Dams, \*Design, \*Evaluation, \*Colorado, Arch dams, Dam construction, Dam design, Outlet works, Stability, Dam foundations, Seepage, \*Crystal dam project(CO), Dam stability.

This study was an independent review of critical engineering data and documentation supplied by the Bureau of Reclamation. No independent site or materials investigations or tests were made. The purpose of this review was to determine if there are any apparent risks of serious distress or failure in filling the reservoir or project operation. Recommendations were made of prudent actions that should be accomplished to provide additional verification of project safety. It was concluded that the site investigations, design, and construction of the dam were conceived and implemented thoroughly and competently. Crystal Dam has inherent safety advantages because of the geologic characteristics of the terrain and the remote location. (Humphreys-ISWS)  
W79-05242

#### REVIEW OF DESIGN, CONSTRUCTION, AND OPERATION OF PUEBLO DAM PROJECT, COLORADO

Wahler (W. A.) and Associates, Palo Alto, CA. Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 678. Price codes: A07 in paper copy, A01 in microfiche. June 1977. 168 p, 14 fig, 9 tab, 159 ref, 1 append, 12 photo. Dept Int 14-01-000C-10

Descriptors: \*Hydraulic structures, \*Dams, \*Design, \*Colorado, \*Evaluation, \*Hydraulic design, Dam design, Reservoir operation, Buttress dams, Concrete dams, Dam foundations, Dam construction, Earth dams, Outlet works, Embankments, Spillways, Stability, Safety, \*Pueblo Dam Project(CO), \*Dam safety, Fryingpan-Arkansas Project, Zoned embankments, Dam stability.

This study was an independent review of critical engineering data and documentation supplied by the Bureau of Reclamation. No independent site or materials investigations or tests were made. The purpose of this review was to determine if there are any apparent risks of serious distress or failure in filling the reservoir or project operation. Recommendations were made of prudent actions that should be accomplished to provide additional verification of project safety. On the basis of available information, it was concluded that the reservoir behind Pueblo Dam should not be permitted to rise above its present level until certain supplementary investigations and/or actions have been completed. A principal concern relates to the stability and performance of the earth-fill embankments. Also, although the design and construction of the central concrete structure (massive-head buttresses) appear to have been executed adequately, its performance may be less favorable than expected. (Humphreys-ISWS)  
W79-05243

#### REVIEW OF DESIGN, CONSTRUCTION, AND OPERATION OF RIRIE DAM PROJECT, IDAHO

Wahler (W. A.) and Associates, Palo Alto, CA. Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 684. Price codes: A08 in paper copy, A01 in microfiche. May 1977. 132 p, 10 fig, 3 tab, 35 ref, 1 append, 14 photo. 14-01-0001-77-C-10.

Descriptors: \*Hydraulic structures, \*Dams, \*Design, \*Evaluation, \*Idaho, Earth dams, Rock-fill dams, Outlet works, Stability, Dam construction, Dam foundations, Embankments, Seepage, \*Ririe Dam(ID), Zoned embankments, Dam stability.

This study was an independent review of critical engineering data and documentation supplied by the Bureau of Reclamation and the Corps of Engineers. No independent site or materials investigations or tests were made. The purpose of this review was to determine if there are any apparent risks of serious distress or failure in filling the reservoir or project operation. Recommendations were made of prudent actions that should be accomplished to provide additional verification of project safety. It appears that the site investigation, design, and construction were carried out thoroughly and competently. Some general recommendations were provided. (Humphreys-ISWS)  
W79-05244

#### REVIEW OF DESIGN, CONSTRUCTION, AND OPERATION OF NAMBE FALLS DAM PROJECT, NEW MEXICO

Wahler (W. A.) and Associates, Palo Alto, CA. Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 682. Price codes: A07 in paper copy, A01 in microfiche. May 1977. 131 p, 7 fig, 1 tab, 97 ref, 1 append, 8 photo. Dept Int 14-01-0001-77-C-10.

Descriptors: \*Hydraulic structures, \*Dams, \*Design, \*Evaluation, \*New Mexico, Arch dams, Earth dams, Safety, Dam foundations, Loads(Forces), Grouting, Grout curtains, Seepage, Dam construction, \*Nambe Falls Dam(NM), \*San Juan-Chama Project, Zoned embankments, Dam safety, Thrust blocks.

This study was an independent review of critical engineering data and documentation supplied by the Bureau of Reclamation. No independent site or materials investigations or tests were made. The purpose of this review was to determine if there are any apparent risks of serious distress or failure in filling the reservoir or project operation. Recommendations were made of prudent actions that should be accomplished to provide additional verification of project safety. It was recommended that Nambe Falls reservoir not be allowed to fill until the Bureau carefully assesses the risks associated with certain areas of concern. (Humphreys-ISWS)  
W79-05247

#### CONCEPTUAL REVIEW AND PRELIMINARY DESIGN OF MULTIFARIOUS WATER INTAKE STRUCTURES

Polytechnic Inst. of New York, Brooklyn. Dept. of Civil and Environmental Engineering.

A. S. Goodman.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 965. Price codes: A08 in paper copy, A01 in microfiche. Report No. NYSERDA 75/29, August 1977. 159 p, 21 fig, 7 tab, 30 ref, 7 append.

Descriptors: \*Intake structures, \*Fish guiding, \*Fish barriers, \*Hydraulic structures, \*Tidal streams, Estuaries, Tidal effects, Cooling water, Electric power plants, Fish behavior, Velocity, Design, \*Traveling screens.

Planning analyses and preliminary design drawings were presented for a multifarious water intake structure which implies many parts or elements. Layout and operating details are for an intake serving a 350-550 Mw thermal power generating unit located on an estuary. The approximate cost would be \$12 million. The principal design features are: adjustable louvers to act as a behavioral barrier to fish; curtain walls in front of the screens to provide for selective water admission to reduce impingement of aquatic organisms; horizontal traveling screens which move in the direction and speed of ambient water flow to guide fish and reduce the degree of impingement; and fish handling facilities to convey organisms back to their

Soil Mechanics—Group 8D

natural environment. The intake, as a whole, is a major departure from the current state-of-the-art of intake design. (Adams-ISWS)  
W79-05248

8B. Hydraulics

**BEHAVIOUR OF A HYDRODYNAMIC FINITE ELEMENT MODEL,**  
Waterloo Univ. (Ontario). Dept. of Civil Engineering.  
R. A. Harrington, N. Kouwen, and G. J. Farquhar.  
Advances in Water Resources, Vol. 1, No. 6, p 331-335, December 1978. 9 fig, 6 ref.

Descriptors: \*Hydrodynamics, \*Flow, \*Model studies, Mathematical models, Finite element analysis, Equations, Analytical techniques, Streamflow, Discharge(Water), Rivers, Jetties, Outlet works, Hydraulics.

A finite element model which solves the vertically integrated momentum and continuity equations was described. Linear triangular elements were used to describe the geometry and parameter variations. The Galerkin method of weighted residuals was employed to cast the equations in a form amenable to numerical solution. The model was based on a fully implicit formulation using finite differences for the temporal derivatives. Means of evaluating the non-linear terms of the governing equations were described, and model results were presented for a frictionless tidal channel. The example was chosen such that the non-linearities have a large influence on the solution, and as a result the linearization scheme significantly affects the model's behavior. Suppression of the non-linear instabilities generated by the convective terms in the momentum equations was examined for the case of flow around a 180 deg bend. Both the imposition of artificially high roughness coefficients and the use of an effective eddy viscosity were examined in terms of their ability to damp the oscillations which arise for this example. Model results were presented for a case study involving determination of remedial measures to improve flow conditions at a river outfall in Southern Ontario. (Sims-ISWS)  
W79-05020

**PRESSURE LOSSES ACROSS TRICKLE IRRIGATION FITTINGS AND EMITTERS,**  
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.  
T. A. Howell, and F. A. Barinas.  
Paper No. 78-2014, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 12 p, 16 fig, 1 tab, 7 ref, ASAE, St. Joseph, Michigan.

Descriptors: Energy loss, \*Irrigation design, Flow rates, Pipelines, Pressure conduits, Irrigation systems, Water pressure, Hazen-Williams equation.

Pressure losses across on-line trickle emitters were measured. The energy losses as expressed by the equivalent length of pipe were described by a power function. The empirical coefficients were related to the emitter characteristics of protrusion depth and area. Lateral design procedures and examples are presented. Pressure losses across PVC and PE barbed fittings were measured. (Skogerboe-Colorado State)  
W79-05060

**TRICKLE IRRIGATION TUBING HYDRAULICS,**  
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.  
G. Z. Watters, and J. Keller.  
Paper No. 78-2015, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 18 p, 16 fig, 2 tab, 12 ref, ASAE, St. Joseph, Michigan.

Descriptors: Pipe flow, \*Irrigation systems, Head loss, Darcy-Weisbach equation, Moody resistance

diagrams, \*Pipelines, Hazen-Williams equation, Trickle irrigation.

Laboratory experiments show that the Darcy-Weisbach equation for hydraulically smooth pipes should be used to compute friction losses in PVC pipe and plastic tubing. Simple formulas are presented to accomplish this. Graphs to find equivalent lengths for emitter connection losses are given. Techniques for calculating head losses in multiple-outlet lines are presented. (Skogerboe-Colorado State)  
W79-05061

**SIMULATED FLOW RATE REQUIREMENTS FOR SOME FLUSHING EMITTERS,**  
Rain Bird Technical Services, Logan, UT.  
K. Solomon, and J. C. Bezdek.  
Paper No. 78-2016, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 18 p, 3 fig, 5 tab, 8 ref, ASAE, St. Joseph, Michigan.

Descriptors: \*Flow rates, Simulation analysis, Hydraulic models, \*Trickle irrigation, Lateral conveyance structures, Model studies, Irrigation systems, Water pressure.

A steady state simulation model was used to study the hydraulic behavior of trickle irrigation laterals and manifolds employing automatic flushing emitters. The influence of emitter characteristics and design values such as emitter operating pressure, flow rate, spacing, and lateral length were considered. (Skogerboe-Colorado State)  
W79-05062

**FLOW RESISTANCE OF LARGE-SCALE ROUGHNESS,**  
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 2E.  
W79-05141

**THE GROWTH AND DECAY OF A HYDRAULIC JUMP,**  
University Coll., Galway (Ireland).  
M. F. McCarthy, and P. M. O'Leary.  
Journal of Hydrology, Vol. 39, No. 3/4, p. 273-285, December 1978. 4 fig, 9 ref.

Descriptors: \*Hydraulic jump, \*Canals, \*Waves(Water), Bores, Analysis, Mathematical studies, Equations, Hydraulics, Numerical analysis, Wave propagation, Critical jump, Amplitude, Shallow water waves, Shock amplitude equation.

Discontinuity analysis is employed to study the propagation of a hydraulic jump in a canal of uniform width but variable length. In particular, a differential equation was derived which determines the manner in which the height of the jump varies as the wave propagates, and the criteria were established which must be satisfied if the wave is to grow, decay, or propagate at constant amplitude. (Lee-ISWS)  
W79-05146

**MODELING TWO-DIMENSIONAL CIRCULATING FLOW,**  
Hydraulics Research Station, Wallingford (England).  
G. H. Lean, and T. J. Ware.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY1, Proceedings Paper 14312, p 17-26, January 1979. 3 fig, 10 ref, 2 append.

Descriptors: \*Circulation, \*Model studies, \*Flow, Dispersion, Hydraulics, Mathematical models, Numerical analysis, Hydraulic models, Shear stress, Equations, Turbulence, Laboratory tests. \*Fluid flow.

Theoretical analysis and numerical experiments were presented to demonstrate some of the difficulties in modeling two-dimensional circulating flow. It was shown that in cases of practical inter-

est, the lateral mixing of momentum, which is essential to support the circulation, can arise in computational models from wholly spurious numerical dispersion effects. Laboratory flume measurements of the flow in the wake of a plane obstruction were presented. It was shown that the horizontal velocity profiles across the eddy indicate that the turbulent lateral mixing rate is appropriate to a shear layer mixing rather than to bed-generated turbulence. Criteria for the conditions under which shear layer turbulence dominates were presented. The practical implications for numerical and physical models were reviewed. (Lee-ISWS)  
W79-05255

**A MODEL STUDY OF ST. MARYS RIVER ICE NAVIGATION,**  
Acres International Ltd., Niagara Falls (Ontario).  
For primary bibliographic entry see Field 2C.  
W79-05278

8C. Hydraulic Machinery

**A SOLAR-POWERED PUMP FOR IRRIGATION,**  
Battelle Columbus Labs., OH.  
For primary bibliographic entry see Field 3F.  
W79-05287

8D. Soil Mechanics

**REVIEW OF DESIGN, CONSTRUCTION, AND OPERATION OF SOLDIER CREEK DAM PROJECT, UTAH.**  
Wahler (W. A.) and Associates, Palo Alto, CA.  
For primary bibliographic entry see Field 8A.  
W79-05239

**REVIEW OF DESIGN, CONSTRUCTION, AND OPERATION OF MOUNTAIN PARK DAM PROJECT, OKLAHOMA,**  
Wahler (W. A.) and Associates, Palo Alto, CA.  
For primary bibliographic entry see Field 8A.  
W79-05240

**REVIEW OF DESIGN, CONSTRUCTION, AND OPERATION OF MT. ELBERT FOREBAY DAM AND RESERVOIR PROJECT, COLORADO,**  
Wahler (W. A.) and Associates, Palo Alto, CA.  
For primary bibliographic entry see Field 8A.  
W79-05241

**REVIEW OF DESIGN, CONSTRUCTION, AND OPERATION OF CRYSTAL DAM PROJECT, COLORADO,**  
Wahler (W. A.) and Associates, Palo Alto, CA.  
For primary bibliographic entry see Field 8A.  
W79-05242

**REVIEW OF DESIGN, CONSTRUCTION, AND OPERATION OF PUEBLO DAM PROJECT, COLORADO,**  
Wahler (W. A.) and Associates, Palo Alto, CA.  
For primary bibliographic entry see Field 8A.  
W79-05243

**REVIEW OF DESIGN, CONSTRUCTION, AND OPERATION OF RIRIE DAM PROJECT, IDAHO,**  
Wahler (W. A.) and Associates, Palo Alto, CA.  
For primary bibliographic entry see Field 8A.  
W79-05244

**REVIEW OF DESIGN, CONSTRUCTION, AND OPERATION OF NAMBE FALLS DAM PROJECT, NEW MEXICO.**  
Wahler (W. A.) and Associates, Palo Alto, CA.  
For primary bibliographic entry see Field 8A.  
W79-05247



## Field 8—ENGINEERING WORKS

### Group 8D—Soil Mechanics

#### 8I. Fisheries Engineering

**CONCEPTUAL REVIEW AND PRELIMINARY DESIGN OF MULTIFARIOUS WATER INTAKE STRUCTURES.**  
Polytechnic Inst. of New York, Brooklyn. Dept. of Civil and Environmental Engineering.  
For primary bibliographic entry see Field 8A.  
W79-05248

#### 9. MANPOWER, GRANTS AND FACILITIES

##### 9D. Grants, Contracts, and Research Act Allotments

**ANALYSIS OF RESEARCHABLE WATER PROBLEMS IN THE SOUTH ATLANTIC-GULF REGION.**  
Florida Univ., Gainesville. Water Resources Research Center.  
Water-Resources Research Center, University of Florida Technical Completion Report, 1979. 59 p.  
OWRT X-133 (No. 9076)(1), 14-31-0001-9076.

Descriptors: \*Research priorities, Southeastern US.

The South Atlantic-Gulf Region is generally abundantly supplied with water -- both surface and underground. However, man's activities have created problems of both water quantity and water quality. The effects of improper water planning and management have been devastating in some instances. Systematic analysis of the water resources problems of the region by the directors of the water resources research institutes of the respective states produced the lists of major regional problems and critical research needs presented. (Heaney-Florida)  
W79-05401

#### 10. SCIENTIFIC AND TECHNICAL INFORMATION

##### 10C. Secondary Publication And Distribution

**THE WORLD REMOTE SENSING INDEX, A COMPREHENSIVE GEOGRAPHIC INDEX BIBLIOGRAPHY TO REMOTE SENSING SITE INVESTIGATIONS OF NATURAL AND AGRICULTURAL RESOURCES THROUGHOUT THE WORLD.**  
For primary bibliographic entry see Field 7B.  
W79-05119

##### 10D. Specialized Information Center Services

**WATER KNOWLEDGE TRANSFER: PROCEEDINGS, SECOND INTERNATIONAL CONFERENCE ON TRANSFER OF WATER RESOURCES KNOWLEDGE, JUNE 1977, FORT COLLINS, COLO.**  
Water Resources Publications, Fort Collins, Colo., 1978. 2 Vols. Neil S. Grigg, Principal Editor.

Descriptors: \*Information dissemination, \*Technology transfer.

Water resources knowledge transfer seeks to make best use of scientific and technical information in water management. It is an important process in water research management because its outcome determines the effectiveness of entire programs. The report contains an analysis of the problem in the water sector, a general overview of the 'technology transfer' question, presentation of conceptual models for transfer, and recommendations for policy changes. (See W79-05410 thru W79-05413)

W79-05409

**A CONCEPTUAL MODEL OF THE KNOWLEDGE TRANSFER PROCESS.**  
Colorado State Univ., Fort Collins. Dept. of Sociology.  
E. Vlachos.

In: Water Knowledge Transfer. Volume 1, Proceedings of the Second International Conference on Transfer of Water Resources Knowledge, June 1977, Fort Collins, Colorado. N.S. Grigg, et al., Eds., Water Resources Publications, Fort Collins, Col., 1978, p 5-22. 2 fig, 17 ref.

Descriptors: \*Water resources, \*Information transfer, \*Communication, Technology, SMCRC model, Diffusion of knowledge, Feedback, Transmission process.

This present Conference, as well as the first international conference on water knowledge transfer, had to grapple with problems of semantics, theoretical differentiations, and difficulties in separating 'information dissemination' from 'technology transfer,' 'science,' 'production,' and a great variety of other terms, definitions, concepts, or theoretical constructs. The field of water resources knowledge has experienced the same growth and transfer problems and opportunities. A variety of producers of knowledge, of overlapping transfer agents, and of ultimate users participate in a complex system of information exchange. This Conference, as well as its predecessor conference, has attempted to develop a systematic framework exemplified by a series of interlocking questions, in order to better understand such a complex system and to take stock of trends and developments in the field of water resources. This paper attempts to provide a continuity in themes between the two international conferences and also outlines some broad concerns associated with the general topic of transfer of knowledge. Discussed are (1) the general field of knowledge transfer; (2) some dominant theoretical approaches and interpretations; (3) the characteristics of the transfer process; and (4) problems and prospects associated with the diffusion and implementation of knowledge. An important conclusion drawn is that the capability of individuals to assimilate knowledge is highly dependent on the capacity of the surrounding social system to provide mechanisms for change. (See also W79-05409) (Bell-Graf-Cornell)  
W79-05410

**STORMWATER MANAGEMENT MODEL: TRANSFER OF TECHNOLOGY.**  
Environmental Protection Agency, Washington, DC. Office of Research and Development.  
For primary bibliographic entry see Field 5B.  
W79-05412

**A WATER DEMAND AND WASTEWATER DISPOSAL MODEL FOR OPTIMUM TRANSFER OF WATER RESOURCES TECHNOLOGY IN DEVELOPING COUNTRIES.**  
Federal Univ. of Paraiba, Campina Grande (Brazil). Dept. of Civil Engineering.  
For primary bibliographic entry see Field 6D.  
W79-05413

# SUBJECT INDEX

## ABSORPTION

Trace Metal Contamination of the Rock Scallop, Hinnites Giganteus, Near a Large Southern California Municipal Outfall, W79-05096 5B

Trophic Level Accumulation of Heavy Metals in a Coal Ash Basin Drainage System, W79-05108 5A

The Uptake, Translocation and Metabolism of Dichlobenil in Selected Aquatic Species, W79-05331 5C

## ACARTIA CLAUSII

Population Dynamics and Production of a Planktonic Marine Copepod, Acartia Clausii, in a Small Temperate Lagoon on San Juan Island, Washington, W79-05346 5C

## ACCELERATED EROSION

Reconnaissance Assessment of Erosion and Sedimentation in the Canada De Los Alamos Basin, Los Angeles and Ventura Counties, California, W79-05172 2J

## ACETYLENE REDUCTION

Nitrogen Fixation (Acetylene Reduction) by Epiphytes of Freshwater Macrophytes, W79-05338 5C

## ACID MINE WATER

Acid Mine Water Reverse Osmosis Test at Kittingham, Pennsylvania, W79-05071 3A

## ACOUSTICS

Acoustic Monitoring of Industrial Chemical Waste Release at Deep Water Dump Site 106, W79-05264 5B

## ACROSYPHYTON PURPURIFERUM

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# ABSTRACT SOURCES

SOURCE	ACCESSION NUMBER	TOTAL
A. CENTERS OF COMPETENCE		
Colorado State University Irrigation Return Flow Quality	W79-05051--05069 05287--05313	46
Cornell University, Policy Models for Water Resources Systems	W79-05010 05269--05283 05285--05286 05410--05413	22
DOE Oak Ridge National Laboratory, Nuclear Radiation and Safety	W79-05435--05489 05491--05495	60
Illinois State Water Survey Hydrology	W79-05012--05043 05119--05148 05235--05268	96
Institute of Paper Chem., Water Pollution from Pulp and Paper Industry	W79-05416--05427 05430--05434 05496--05500	22
University of Wisconsin, Eutrophication	W79-05231 05322--05326 05328--05335 05337--05341 05344--05347 05349--05356 05428--05429 05490	34
University of Wisconsin, Water Resources Economics	W79-05315--05320	6
B. STATE WATER RESOURCES RESEARCH INSTITUTES		
	W79-05001--05009 05046--05050 05090--05092 05225 05227--05230 05233--05234 05397--05400 05415	29

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SOURCE	ACCESSION NUMBER	TOTAL
C. OTHER		
BioSciences Information Service	W79-05226, 05284 05314, 05321 05327, 05336 05342--05343 05348, 05382	10
Environmental Information Services, Inc. (Effects of Pollutants on Aquatic Life)	W79-05093--05114 05174--05211	60
Forest Service (USDA)	W79-05044	1
Information Planning Associates, Inc.	W79-05070--05089 05357--05371	35
National Oceanic and Atmospheric Administration	W79-05115--05118	4
Ocean Engineering Infor. Service (Outer Continental Shelf)	W79-05212--05224 05392--05396	18
Ocean Engineering Infor. Service (Patents)	W79-05372--05381 05383--05391	19
Office of Water Research and Technology	W79-05011, 05045 05232 05401--05409 05414	13
U.S. Geological Survey	W79-05149--05173	25

U.S. GOVERNMENT PRINTING OFFICE: 1979-281-061/23

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